REPORT RESUMES

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STUDIES IN EDUCATIONAL CLOSED-CIRCUIT TELEVISION.
BY- MARTIN, JOHN R. AND OTHERS
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DESCRIPTORS- *INSTRUCTIONAL TELEVISION, AUDIOVISUAL AIDS, STUDENT TEACHER RELATIONSHIP, *CLASSROOM RESEARCH, STUDENT ATTITUDES, TEACHER ATTITUDES, CLOSED CIRCUIT TELEVISION, *CHEMISTRY, ENGINEERING GRAPHICS, COSTS, *COLLEGE STUDENTS, *COLLEGE TEACHERS, EQUIPMENT STANDARDS, EFFECTIVE TEACHING

THE 3 MOST OBJECTED-TO FEATURES OF INSTRUCTIONAL TV ARE (1) RESTRICTIONS IMPOSED BY THE USE OF A SPECIAL STUDIO, (2) LOSS OF TEACHER-STUDENT CONTACT, (3) THE LIMITED VIEWING AREA OF TV SCREENS. THIS STUDY INVESTIGATED 4 CLOSED-CIRCUIT TV COURSES IN AN ATTEMPT TO MINIMIZE FEATURES (1) AND (2). OVER THE ACADEMIC YEAR 1957-58 AT THE CASE INSTITUTE, COURSES IN GRAPHICS 1 AND 2, CHEMISTRY, AND ELECTROMAGNETIC FIELD THEORY WERE TAUGHT BY CLOSED-CIRCUIT TV. A 2-WAY VIDEO AUDIO SYSTEM PROVED SUCCESSFUL IN PRESERVING STUDENT-TEACHER CONTACT. IT WAS FOUND THAT CONVENTIONAL CLASSROOMS CAN BE SATISFACTORY TV ORIGINATING POINTS. A LIVE CLASS WAS PRESENT IN THE ORIGINATING ROOM. EQUIPMENT WAS CHOSEN FOR MAXIMUM MOBILITY AND DEPENDABILITY. EQUIPMENT USED AND OPERATING COSTS ARE DISCUSSED. THERE WAS NO CONTROLLED EVALUATION OF STUDENT ACADEMIC ACHIEVEMENT. STUDENT AND INSTRUCTOR ATTITUDES WERE MEASURED BY QUESTIONNAIRE. STUDENTS GENERALLY PREFERRED LIVE INSTRUCTION, WHILE INSTRUCTOR ATTITUDES VARIED. IT WAS CONCLUDED THAT TV IS MOST VALUABLE AS AN INSTRUCTIONAL AID, NOT AS A MEDIUM. TV WAS NOT FOUND SUITABLE FOR TEACHING ABSTRACT MATERIAL. TV SHOULD BE USED AS AN INSTRUCTIONAL MEDIUM ONLY WHEN TEACHING STAFF OR LECTURE FACILITIES ARE NOT ADEQUATE. STUDENTS WERE FAVORABLE TOWARDS TV AS AN AID. FURTHER DETAILS AND SUGGESTIONS ARE GIVEN. (MS)

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Studies in Educational Closed - Circuit Television

JOHN R. MARTIN
R. B. ADAMS
M. C. BARON

Research Report
No. 948-5

CASE INSTITUTE OF TECHNOLOGY
UNIVERSITY CIRCLE · CLEVELAND 6, OHIO

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STUDIES IN EDUCATIONAL CLOSED-CIRCUIT TELEVISION

By

John R. Martin
Richard B. Adams

Case Institute of Technology
Cleveland, Ohio

and

Martin C. Baron

Kent State University
Kent, Ohio

Research Report Number 948-5

Under Grant From
Committee on Utilization of College Resources
Fund for the Advancement of Education

Submitted by:

John R Martin
John R. Martin
Associate Professor
Department of
Electrical Engineering

Approved by:

Samuel Seely
Samuel Seely
Head
Department of
Electrical Engineering

Case Institute of Technology

Cleveland, Ohio

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1	Line 1, paragraph 2. Read spring for Spring.
12	Line 1, Section C-1. Read were for was.
16	Line 6, paragraph 3. Read source for sourse.
24	Line 3, paragraph 3. Read principal for princepal.
27-28	Interchange page numbers.
27	Line 4, paragraph 1. Read wave equations for ferro-magnetism.
29	Line 2, paragraph 3. Read free for fee.
40	Line 9, Section 1. Read commercial for commerical.
40	Line 2, Section 5. Read 1958 for 1957.
43	Line 2, paragraph 2. Read Figures 1 and 3 for Figures 1 and 2.
45	Line 1, paragraph 3. Read Figure 3 for Figure 2.
55	Reference 3. Read 1957 for 1958.
55	Reference 4. Read 1958 for 1957.

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I. INTRODUCTION

During the past few years there has been a great deal of interest in the use of television in education. Much of this interest has been due to the problems of increasing student enrollments without corresponding increases of competent teaching personnel. Pioneer studies of the use of television as a teaching medium have been made by Pennsylvania State University,(1,2) Miami of Ohio,(3,4) New York University,(5) and others.(6) These studies were initially directed toward comparisons of student achievement in television and conventional classes. In addition, their continuing research has included questions as to types of courses best suited for televised instruction, optimum class size, and other educational problems. The results of these studies have shown that in practically every case, if the usual measures are used as the criteria of learning, there is no significant difference between conventional and televised instruction for a wide variety of subject matter.

Case Institute of Technology initially became interested in the use of television as an instructional aid rather than as a teaching medium.(7) The demonstration of remote instrument assemblies, large group observation of images normally available to only one person at a time, remote viewing of research operation and the enlarging ability of the camera are all cases where television can be of considerable value in improving the quality of engineering instruction. It may, however, be difficult to justify its use as an instructional medium where the student to instructor ratio is low, as is the condition at Case.* Students who pay a high tuition with the objective of receiving small group and highly personal instruction may be expected to resent any form of mass education, no matter how effective it might be. A similar attitude may also be found in a faculty trained in the small class tradition.

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*Registrar's report for 1956-57 gives a student to instructor ratio of about six to one.

The limited sampling possible from a small student body, combined with restrictions of an established rigid system of scheduling, made it seem doubtful that any rigorous or well controlled evaluation of the effectiveness of instructional television would be possible or of any significant value. At the same time, there seemed to be a number of areas in which an engineering institute might be able to make some worth while contributions. These included improvements in the design and the use of physical facilities, and in the application of electronic and communication developments to permit a wide utilization of television engineering principles in the general field of education.

In the Spring of 1956, Case Institute of Technology was awarded a grant from the Committee on the Utilization of College Resources of the Fund for the Advancement of Education to implement studies in several methods for extending the usefulness of educational television. An additional grant in the Spring of 1957 permitted these studies to be continued until September 1958. This report is one of several which separately describes the various aspects of the investigations. (7) (8) (10)

II. OBJECTIVES

In spite of the impressive statistical evidence as to the effectiveness of television instruction, its acceptance has not been universal, and a number of criticisms have been directed toward its use. The three aspects most frequently objected to are (1) the change of teaching techniques and environmental conditions necessitated by the use of a special television studio, (2) the loss of personal contact between instructor and the remote students, and (3) the limited viewing area of presently available viewing screens. While some of these criticisms may be due to lack of familiarity with televised instruction, or to a reluctance to depart from familiar and satisfactory teaching methods, other suggest that something may be lost in televised instruction which is not measured by usual testing methods.

This report is a description of experience in several closed-circuit television courses in which the principal objectives were to investigate methods by which the first two factors suggested above could be minimized. An answer to the objection of a limited field of view has been devised, but no experience was obtained during the experiments reported here. It is presently in development and will be described in a later report.

Although practically all studies have indicated that conventional classrooms are not generally suitable as teaching originating points, there are many instructors who object to the change of environment from a familiar classroom to that of a special studio. There are also, undoubtedly, some cases where space for studio may not be available, or the cost of properly equiping such space may be prohibitive. It would be unfortunate if schools of modest financial resources were to obtain the impression that effective televised instruction is impossible without the use of studio facilities. The limitations of conventional classrooms as program originating points and the possibilities of minimizing their objectionable features were therefore investigated as part of these studies.

A two-way video-audio system was developed in an effort to reduce the loss of personal contact between student and instructor and the value of this operation noted.(8) A live class was also present in the room with the instructor for all except a few studio type of presentations, to further provide familiar classroom teaching conditions. Although the presence of a live class has generally been considered as reducing the effectiveness of televised instruction, it was believed desirable to include this condition as part of the studies on teaching environment.

Although this report is chiefly concerned with problems associated with television as a medium of instruction, continuing studies have been made on its use as a teaching aid. The philosophy and problems associated with this application have been previously detailed,(7) but additional experiences and conclusions are also included in the present report.

To implement the type of procedures followed in the studies at Case, it was also necessary to develop facilities quite different from those generally used for television instruction. Instead of an installation of a permanently located central "hub" studio, all equipment was designed for maximum mobility. Since any classroom, lecture hall, laboratory or research area might be used as either the program originating point or viewing position, all equipment must be capable of being moved from one location to another, set up, put into operation and removed in a very short time. For maximum utilization of the television program it is also desirable that the equipment be available for use in any of the other twelve buildings on the Case campus. Since some reports on televised instruction have seemed to imply that equipment costs might be considered prohibitive for schools with limited budgets, the equipment at Case has been chosen and developed with the objective of the lowest capital expenditures consistant with dependable operation.

It should be emphasized that the studies described in this report have dealt with the development of a system which will provide acceptable conditions for televised instruction rather than with a comparison of the effectiveness of televised and conventional teaching. As such, the principal emphasis of the report is on engineering problems and their solutions rather than on details of methods used to determine attitudes. However, questionnaires were used to determine specific problem areas, and to evaluate the success of the attempted solutions.

To summarize, the overall objectives of the studies at Case may be stated as follows:

1. A study of environmental teaching conditions which provide a more familiar classroom atmosphere than the more generally used studio instruction. This involves,
    a) the development of a two-way video and audio system
    b) the inclusion of a live class at the instructor position
    c) modification of conventional classrooms necessary for satisfactory operating conditions
2. An evaluation of attitudes of students and instructors towards televised instruction.
3. Studies in the use of television as a teaching aid.
4. The development of flexible, dependable operational equipment facilities at moderate costs.
5. The development of new techniques and equipment facilities for use in educational television.

III. SUMMARY OF CONCLUSIONS

Conclusions and several recommendations resulting from the studies are summarized below. The data on which these are based are given in the body of the report.

A. Television as a Medium of Instruction

General

1. The use of closed-circuit television as a teaching medium should be limited to those cases where live instruction is difficult or impossible. These conditions are:
    - a) Lack of suitable large lecture rooms
    - b) Lack of qualified teaching staff
2. Lecture rooms with live instruction are generally preferred by both students and instructors to small class room instruction by television. However, other factors being equal, students prefer a good instructor on television to live instruction from a poor teacher.
3. Television can be used to reduce the limitations of very large lecture rooms by the use of cameras and properly distributed receivers in the lecture room itself. In this way effective use can be made of close-up views of the instructor, graphical or written material, demonstrations, etc., without the loss of personal contact with the instructor.
4. Television should not be used as an instructional medium unless there is a specific and evident reason for its use. This need should be recognized and accepted by both students and instructors.

5. Large group instruction, whether by television or in a lecture room is best suited to informational material, rather than topics requiring discussion or the interchange of ideas. It has the following advantages:

    a) All students receive identical instructional material

    b) A single, well presented lecture is usually more effectively presented than the same material repeated over and over to a number of small groups

    c) Lecture material can be shared by a number of instructors, each responsible for the area of his particular interest or competance. Other instructors are thus released for other professional or scholastic activities

6. Large group instruction, whether by television or in a lecture room, has the following disadvantages:

    a) Loss of personal contact between individual students and instructor

    b) Difficulties of asking or answering of questions by either students or instructors

    c) Impossibility of free discussion

7. No significant difference in scholastic achievement between televised and live instruction was observed for the courses used, although instructional patterns and environmental conditions were varied during the course of the experiments.

8. The most serious and objective criticism of televised instruction on the part of both students and instructors is the limited viewing area available. This is particularly true where the visual portion of the subject matter is of greater importance than the image of the instructor.

9. Material most difficult to present on television is that involving step-by-step developments of written or graphical material, and which normally requires that large areas remain in the field of view at one time.

10. In courses where the medium was most effectively used, instructors found it necessary to make much more careful preparation for television than for conventional classes.

11. Students were keenly aware of any lack of careful preparation and were critical of occasions when the instructor did not seem aware of the limitations of the medium.

12. Students expect near professional images on viewing screens, and are very critical of any poor technical operation.

13. Although no careful cost accounting has been made in the present studies, the extra time required for preparation and rehearsal, the necessity for room proctors, maintenance and technical operating costs, make it doubtful that televised instruction results in any significant financial savings.

Environmental Conditions

1. Conventional class rooms are satisfactory to both student and instructors as program originating points, provided certain physical conditions are maintained. These conditions are defined in the body of the report.
2. Instructors generally prefer a live class taught simultaneously with remote TV classes. The effect of this condition on remote classes is negligible, especially if a two-way video system is used.
3. The effect of an instructor speaking to each student individually, obtained in a studio without a live class present is of importance in only a few courses.
4. Except for chalk-board lighting, no modification of normal class room illunination is necessary or desirable.
5. Chalk-boards are not generally effective for presentation of graphic or written material.

Two-Way Operation

1. Two-way video operation between remote class rooms and instructors is practical and desirable for most instructional situations.
2. Both instructors and students prefer two-way operation even under conditions where it is not used to any major degree.
3. Two-way video operation has the same limitation as televised instruction in general; that is, the limited field of view on a monitor screen.
4. Two-way video operation is limited by the number of remote sections which can be effectively monitored. This is the same limitation which exists in a large live class in a single room. However, students in remote rooms are not conscious of the other sections and therefore have a tendency to demand more attention than when part of a single large group.

5. Two-way video operation between different remote class rooms is possible and may have some educational merit for certain types of courses. It has not, however, been investigated in detail.
6. Two-way audio communication between different remote class rooms is possible, but gives rise to difficult operational problems of audio feed-back.
7. Two-way audio operation between remote class rooms and the instructor is both practical and desirable for most instructional situations. The only exception is where the nature of the subject matter makes interruptions of the presentation undesirable.

Recommendations

1. Instructors should not be required to teach television courses unless they are convinced of its necessity or value.
2. Allowance should be made in faculty teaching loads for the extra time required for preparation and rehearsal of televised programs.
3. Opportunity for small group discussions, clarification of detail, etc., should be provided for the remote groups after the televised presentation. Personnel in charge of these groups should witness the televised lectures. If scheduling conditions make this impossible, the television lectures should be available for consultation by the students.
4. It is desirable to rotate live and remote sections. While this precludes the possibility of comparing live and televised instruction, it may greatly improve student acceptance.
5. Instead of requiring the student to copy a great deal of material from a chalk board or other methods of written presentation, students should be provided with mimeographed copies of the material to be presented.

Note: The last three recommendations given above are the result of experience with the classes studied in this experiment only. They would probably also be true for technological courses in general, and particularly so for schools with a tradition of small group instruction. Pennsylvania State University has considered these points in some detail and has concluded that the problem is dependent on the instructor and the type of subject matter.(2)

B. Television as a Teaching Aid

General

1. The most valuable contribution of television to teaching is its use as an aid rather than as a medium of instruction. This use however, is generally restricted to courses involving physical phenomena. It is not suitable for use in the teaching of abstract material.

2. Visual information is made available which would not be possible by any other methods except photographic projection.

3. Televised visual information is superior to photographic projection for two important reasons:

    a) photographic methods involve time delay which is often undesirable.

    b) televised viewing is under the control of the instructor and can be interrupted and repeated under different conditions as desired by the viewing class.

4. All members of a class have an identical view of the material being demonstrated. This is of particular importance in the observation of three dimensional objects.

5. Areas of restricted dimensions are equally available to small and large groups.

6. Remote laboratories, research projects, close ups of dangerous phenomena, etc., can be observed without leaving the class room.

Methods and Equipment

1. Demonstrations are best conducted by the instructor remaining in the lecture or class room, and the equipment in the remote position operated by an assistant at the direction of the instructor.

2. Material is generally best shown at its normal location. Televising from a studio usually prevents the demonstration of delicate, heavy, complex, or dangerous equipment.

3. Televising from a multiplicity of remote positions to class or lecture rooms requires very mobile equipment facilities. These are described at a later point in this report.

Acceptance Attitudes

1. Student acceptance of this use of television is very high in contrast to the generally adverse attitude toward its use as a medium of instruction.

2. Instructor attitudes range from lukewarm to enthusiastic depending on their interest in student comprehension, imagination, available time and energy. Some regard it as being too much trouble; others may feel it occupies too large a portion of class time for the value received.

C. Physical Facilities

Program Distribution Systems

1. Both radio-frequency and video-frequency distribution was used in the studies, depending on the particular operating requirements. A description of the two systems is given in the body of the report, but the principal contrasting characteristics of each is given below.

2. Radio-frequency distribution: Relatively high installation cost, less resolution than video-frequency, may be modified to permit video operation, permits a number of programs to be transmitted simultaneously on the single system, permits the use of standard commercial television receivers as viewing monitors, necessary for two-way video transmission. Sound carried on same cable.

   Video-frequency distribution: Relatively low installation cost, high resolution, requires complex wiring and switching for more than one program at a time, images deteriorate with increasing numbers of viewing monitors, viewing monitor cost relatively high. Sound must be carried on separate cables.

Equipment

1. Two mobile cameras, each equiped with multiple lenses and electronic view finders were used for most programs. A camera control unit, camera switcher, standard synchronizing generator and wave form viewer were provided, as well as a video monitor for each camera. Crystal controlled radio frequency modulated oscillators were used for each of the program channels. Remotely controlled cameras in fixed positions were found too inflexable for most program originations.

2. An electronic slide projector was developed to avoid the necessity for optical projection and for superposition of slide material on the normal image from either camera.

3. Industrial cameras were used in the remote rooms for the two-way video operation and were incorporated as an integral part of the receiver consoles. A control console at the rear of the class room permitted the room proctor to control both camera and receiver.

4. All of the above equipment, with the exception of the receivers were mounted in matching mobile consoles.

   Description and details of the above equipment facilities are given in the body of the report.

Lighting

1. When used as a medium of instruction, it was necessary to originate programs from inside rooms to insure uniform light distribution. Except for chalk-board lighting units, it was not usually necessary nor desirable to use auxilliary lighting.

2. It was necessary to modify commercial chalk-board lighting units to provide uniform board illumination.

3. Room receivers must be shielded from reflections due to room lighting fixtures and room windows.

4. When the system was used as a teaching aid, special mobile lighting units were used to provide both high intensity flat lighting and spot lighting depending on the equipment to be shown. Switching and variac intensity controls are mounted on a mobile console which matches those used for camera equipment.

   The above equipment is described in the body of the report.

Equipment and Operating Costs

1. The total cost of major equipment items used in the Case studies was less than $20,000. The equipment includes four cameras and all auxilliary control equipment, six large and four small room receivers, audio system, and all lighting equipment and modifications. It does not include the building distribution nor the fabrication costs of mobile consoles.

2. Operating cost including tube replacements, maintenance and technician and camera staff labor, but not depreciation, is from $10.00 to $25.00 per instructional hour depending on the complexity of the required set up.

IV. PRELIMINARY INVESTIGATION AND REDEFINITION OF PROBLEM

Because of the general acceptance of studio operation with no live classes present in front of the instructor, the first televised instruction at Case was under these recommended conditions. A number of short time trials were made from a central studio and with no live class present, primarily to obtain information and experience on two-way operation.

The reaction of both participating instructors and observers, however, were strongly against these instructional conditions. The absence of a live class, the necessity for lecturing to impersonal camera lenses, and the high illumination level then thought necessary, were all objectionable features. The fact that they were in two-way contact with the remote classes mitigated their objections to some extent, but the general studio atmosphere was very distasteful. There was also considerable reluctance to depart from familiar teaching methods and opposition to any special preparation or rehearsals desirable for more effective presentations. It was recognized that similar attitudes had been initially encountered in other studies, and had been changed only by insisting that instructors adapt themselves to the unfamiliar teaching environment. The experimental studies at Case, however, depended on the voluntary participation of the faculty in a program for which they felt no particular interest nor believed to be of any significant value. Under these conditions insistance on a studio type of presentation and any great emphasis on special preparation or rehearsal time might have jeopardized the entire experimental program.

It was therefore decided that attention should be directed toward a study of the limitations of conventional class rooms as program originating points and on methods of adapting them to satisfactory operating conditions. Since the instructor reactions mentioned above are not peculiar to Case, it was considered desirable to attempt to remove the causes of these attitudes rather than to try to change the attitudes themselves.

It must be emphasized that the primary objective of this study was to develop an educational television system which would minimize some of the features considered objectionable in the past. It was assumed that there is sufficient evidence to prove that students learn equally well in televised and conventional classes. There was no attempt, therefore, to make rigorous, controlled evaluations of learning in any class except one, the Chemistry class. For other courses the only attention given to scholastic achievement was a cursory inspection of earned grades.

A study of attitudes, however, was utilized to indicate the need for and the value of any changes in the environmental teaching conditions. While some of the questions asked of the students requested them to point out disadvantages and advantages in the TV medium for class room instruction, others asked that they compare TV and live instruction. Since the whole question of the acceptance of educational television, or attitudes toward its use seems to be greatly misunderstood not only by many of its opponents but by many of its proponents as well, it is appropriate that the intended role of these questions be defined at this point.

Aside from its use as a teaching aid, the question is not whether television is better than, or as good as, or to be preferred over live instruction. Television is simply one form of a communication system, serving the same purpose as a letter, a book, the telegraph, telephone, radio, a recording or motion picture. Almost any normal individual would prefer direct contact with the sourse rather than the use of an interposed communication system. But, if personal contact is not possible, than the real question becomes evident: does the use of a communication medium provide an acceptable substitute for live presence? More specifically, if a teacher cannot be seen or heard by any other method, is television an acceptable substitute? Thus, while most questionnaires on attitude seem to be based on the premise that educational television is better than, as good as, or worse than, live teaching, the question of interest in the present study was "Can the television medium be improved so as to maximize the effectiveness of televised instruction by a good teacher?"

The items in the questionnaires employed sought to detect improvable defeciencies in the medium and to evaluate improvements.

Following the pilot study and redefinition of objectives described above, the experiment continued in two parts. In Investigation A, during the Spring semester of 1957, the television medium was used for the teaching of two courses: Graphics I and Chemistry II. During this period, informal reactions of instructors, students and technicians were considered in a continuing effort to make the televised instruction more effective. An evaluation of the program was made at the end of the semester, and such changes as were practical were made in the next phase of the studies. Investigation B continued over both the Fall and Spring semesters of 1957-58 with only minor changes in the instructional procedures. Two courses, Electromagnetic Field Theory and Graphics I were taught by closed circuit television in the Fall term, and Graphics II in the Spring.

V. INVESTIGATION A. SPRING SEMESTER 1957

Room Schedules

The television distribution system of the electrical engineering building at Case provides receiver outlets in all class and lecture rooms, and camera outlets in all laboratories and research areas as well well as most class rooms. Practically any location in the building is therefore a potential program originating point, and the only restriction given the administrative offices was that the rooms assigned have both camera and receiver outlets. Several problems were immediately evident. Only one of the randomly assigned rooms was large enough to permit flexible camera motion, and to accomodate control equipment. This room had a very high use, since it was occupied by classes at every hour of the day, including those immediately before and after the television classes. Fortunately, all equipment had been designed for high mobility, and could be moved in position, put into operation and torn down and removed in the two ten-minute intervals preceding and following a fifty minute class period. This procedure was followed during the first few weeks of operation. Following this all equipment was left in the class room, but protected from tampering by a small booth which also served as a control center for the program. The fact that this booth could be knocked down, removed to another room and set up in about forty-five minutes, emphasizes the flexibility of the Case operation. However, there was no opportunity for trials on various operating conditions, set up of models or other visual aids; nor of any rehearsals even for those instructors who might desire them.

Illumination

Although normal room illumination for inside rooms was adequate for good picture quality, the room used as a lecture originating point had outside window lighting. As a result, the level of illumination varied greatly from one side of the room to the other, making camera adjustments extremely difficult, unless the instructor remained in one position relative to the windows.

Another problem was the contrast conditions on the chalk-board. Normal room illumination was not sufficient to give good contrast, and commercial chalkboard lighting units were unsatisfactory because of the extreme range of light level between the top and bottom of the board. The use of white chalk on "modern" green surfaces gave low initial contrast which was further reduced by repeated erasings. Instructors in the Graphics I* course very quickly substituted white paper sheets for their presentations, resulting in improved contrast, but the Chemistry II* instructors continued to use the chalk-board throughout the year with generally unsatisfactory results.

Two-Way Video Operation

Two-way video operation was technically satisfactory after a redistribution of channel necessitated by adjacent channel and local commercial interference. Limitations of space prevented variations in the position of the remote monitors, and during the Spring term, 1957, the monitors were fixed in position at the back of the room as nearly as possible in line with the cameras.

Audio Operation

Audio operation between remote classrooms and the instructor utilized microphones with cardiod directional patterns mounted on floor stands at the front of the room while instructors used lavalier types. This system enabled a student while remaining in his seat to address a question to the instructor. Since the question could not be heard by students in other rooms, it was necessary for the instructor to repeat the question before answering it.

Presence of Live Class

Rather than lecture from a studio, instructors were televised while addressing a live class. In the courses taught during the course of this investigation the visual material being presented was considered to be of greater importance to the student than a direct eye-to-eye image of the instructor. An occasional shot of the instructor was made to reassure the student of his reality. A monitor, set to the instructor's channel, was placed at the back of the room and permitted the instructor to see exactly the same image as that viewed by the remote group. When vis-a-vis image was appropriate, the instructor could then address his remarks directly to the camera. A second program monitor at the front of the room permitted television viewing by the live class when enlarged close-up shots were made of instructional material.

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*Courses to be described below.

Courses and Instructional Methods

Spring Semester, 1957

Following a number of short time trials during the Fall of 1956, two separate courses were used in Investigation A., and three additional courses were used in Investigation B. Each covered essentially a full semester and are described below in the appropriate sections. Although each course was accompanied by laboratory periods, only the lectures were televised.

Graphics I. Spring Semester, 1957

" . . . a course in engineering drawing, required of all Case freshmen. The material is on the theory of projection, sections and conventions, descriptive geometry and pictorial drawing, including axonometric, oblique and perspective forms. The presentation consists of one hour lecture and four hours drawing room practice per week."*

The lecture material consisted for the most part of the solution of various problems in graphical presentation and required accurate drawings by the instructor.

Two sections of approximately twenty students in each section were the subjects in this experiment. There was one lecture per week alternating between live and two-way television. Two instructors alternated between lecturing and proctoring of the remote section.

*Catalog Description

Students were mid-year entering freshmen, and this was the only course in Graphics I given during this semester.

General Chemistry II. Spring Semester, 1957

" . . . the second semester of general college chemistry required of all Case freshmen . Subject matter includes the descriptive chemistry of metals and non-metals with emphasis on solutions and equilibrium conditions as well as an introduction to organic chemistry."*

There were three hours of lecture-recitation and three hour of laboratory per week. Normal presentation of the material involves considerable chalkboard work covering a large area for the development of chemical equations and mathematical calculation. It is often desirable to refer back to previously written chalkboard material, it usually necessitates that the student take rather complete notes.

Three of the available twenty sections of freshmen were chosen for the experiment because they happened to meet at the same time. Original assignments of students to sections was random, but for the experiment they were redistributed so as to be matched in ability according to a "predicted final grade index" based upon equally weighted first semester grades in physics and chemistry. A fourth section meeting at a different time was chosen as a control. All four sections numbered twenty-one students. There was no rotation of students in this study, each section continuing as live, remote, or conventional control groups during the entire semester.

Four instructors shared the teaching assignment in rotation. Each lectured to the live televised class and to the control section during two time periods and acted as proctors in the remote rooms during the other two time periods.

*Catalog Description

Student Achievement and Reactions of Students and Instructors, Spring Semester, 1957

Graphics I

Student Achievement: The two sections involved were the only ones taking the course, and since both were equally exposed to the two teaching conditions, no direct comparison of teaching values was possible. However, the grades of the group were compared with those of similar groups in previous years. Grades were slightly higher than for former classes of the same type. No significance should be attached to this fact, however, since the difference was small and may have been due to a number of uncontrolled factors.

Student Reactions: An open ended questionnaire was developed and administered at the end of the course. The majority of students preferred live to televised instruction, although they were not as vigorous in their opposition as students in the Chemistry class being taught during the same semester and under comparable conditions. The majority indicated that they would prefer television to live instruction in a large lecture room. They would also prefer a good instructor on television to live instruction from a poor teacher. The questions and a tabulation of the replies are found in Appendix I.

Instructor Reactions: The Graphics I instructors were sufficiently satisfied with the TV medium to continue its use for two additional semesters. A report of their reactions to their three semester experience is presented on page 32 .

Chemistry II

Student Achievement: Two methods were used to determine whether student achievement was effected by type of instruction. One of these involved testing the significance of the difference, for each section separately, between the "predicted final grade index" and the "final earned grade". The "predicted final grade index" was the same as that used to match the students for ability, while the "final earned grade" used as the criterion of scholastic achievement, was a composite of four monthly grades with a weight of three, and the final examination with a weight of one. There was no significant difference between the "predicted final grade index" and the "final grade" for the two remote sections nor for the control section. This difference, however, was significant at the 5 per cent level of confidence for the live section, with the earned grade lower than expected. The second test, an analysis of variance of the final grades of the four sections, showed the mean final grade for the live section significantly lower than those of the other three sections. Tables of data showing these comparisions are presented in Appendix II.

Student Reactions: A Thurston-type attitude scale was used at the beginning and end of the term to indicate changes in attitude. Students in the live television room showed no changes in attitude between the beginning and end of the term. In general there seemed to be no positive or negative feeling toward the experiment.

Students in the remote television rooms changed from a mildly sceptical attitude at the beginning of the term to strong opposition at the end. They recognized that they were part of a situation contrived for the acquisition of data and experience. Since the course is required, and with a natural concern over grades, the students indicated (in conversation) that they regarded themselves as victims, rather than as participants in the experiment. They also resented the fact that the instructors present in the room served no useful purpose except as proctors and could have been used for regular classroom teaching. They were very critical of any technical limitations and regarded their experience as typical of all instructional television.

Students in the control section shifted from a neutral (pre-course) attitude to unfavorable (post-course) attitude, even though they had no direct contact with the televised teaching.

Instructor Reactions: All instructors for this course were experienced teachers of professorial rank who had volunteered for the assignment as a part of their regular teaching load. Their motivation was a sense of obligation to provide a teaching situation for the experiment and a curiosity as to the use of television in their departmental courses. Since no allowance was made in their load for special preparation or rehearsal time, it was agreed at the beginning of the course that no concessions would be made to the medium and that as far as possible they would employ their usual techniques. As a result, all camera operation was on a completely extemporaneous basis.

They were unanimous in their opinion that instructional television is not a satisfactory substitute for live courses in freshmen chemistry as now taught at Case. Their princepal criticisms were directed toward the loss of personal contact with remote students, and limitations in the use of the chalkboard. At the same time the presentation of the same material to all sections simultaneously was recognized as having some value, and courses for the year 1958-59 will be presented in large lecture groups instead of single sections as in the past. They also recognized the value of television as a teaching aid, and plan to make use of this application in future courses.

General Evaluation of Conditions During Spring Semester, 1957

Two-Way Video Operation

Only two criticisms were directed toward the use of two-way video after initial adjacent channel interference was corrected. The first is the same as that made of all television images, i.e., the diminished field of view. The second was that instructors had a tendency to ignore the remote room monitors in favor of a live class. This is, however, a minor factor for the type of classes taught in this experiment, as will be discussed at a later point.

Audio Operation

It will be recalled that students could, while remaining in their seats, spontaneously address a question to the instructor. This question was not audible, however, to students in the other rooms. This procedure produced reactions which had not been anticipated and for which no completely satisfactory solution has been found. Students wanted to hear not only the instructor, but questions asked from all rooms. Although this is technically possible, it requires extremely careful setting of volume levels in all rooms to avoid acoustic feedback. Some schools have solved the problem by a hand microphone-switch-signal unit passed by a proctor to students who wished to ask a question from a remote room. However, in our particular operation any room may be used as a program originating point, and such a method would require considerable awkward cable conditions. We also believed that the passing of microphones from hand to hand would tend to inhibit spontaneous questions, and therefore would be still another departure from normal classroom conditions. The simplest procedure was to have the instructor repeat the questions for the benefit of the classes other than the one in which the questioning student was seated. Although the same procedure is necessary in a large conventional lecture room, it was never accepted by instructors nor by students as a completely satisfactory procedure.

Presence of Live Class

It was found that the presence of a live class with the instructor could not be considered in any way as harmful to the presentation in the courses studied. Neither students nor instructors were particularly distrubed by the presence of cameras and control equipment after the initial novelty of the situation had passed. In view of the more acceptable and familiar environment to the instructor and the acceptance by both the live and remote students, there seemed to be little reason for eliminating the live class, except for those cases where a direct face-to-face image of the instructor is a constant and necessary part of the presentation.

VI. INVESTIGATION B. FALL AND SPRING SEMESTERS, 1957-58

PHYSICAL CONDITIONS

As a consequence of the experience gained during Investigation A., changes were instituted during the Summer of 1957 and courses were conducted in the Fall and Spring semesters of the 1957-58 school year under these new physical conditions.

Rooms and Illumination

The instructor position was moved to an inside room with all artificial illumination, and was sufficiently large to contain the control booth as well as to permit free camera motion without affecting the live class. The commerical chalkboard lighting unit was modified so as to give essentially constant illumination over the entire board space. No other classes were scheduled for this room which would interfere with preparations for the television programs. It might be argued that under these conditions the room is actually a special studio. However, there were no changes in the physical construction of the classroom and no special lighting was installed except for the chalkboard unit, which only improved its value for conventional teaching. The room can be reconverted to normal use in less than one hour simply by removing the television equipment.

Audio and Video Operation

In addition to a change in location of the program originating point, other improvements were made in the over-all system. All rooms were interconnected by sound power phones over the existing television distribution system. Additional monitors were added to improve the instructors video contact with the remote rooms. Remote camera and receiver controls were added at the proctor's position in the viewing rooms, and each viewing room receiver and camera combined into a single mobile console. The use of an electronic projector for lantern slides eliminated the necessity for optical projection.

Courses and Instructional Methods

Fall and Spring Semesters, 1957-58

Electric and Magnetic Fields, Fall Semester, 1957

" . . . a course in field theory required of all junior electrical engineering students. Material covers the fundamental laws of Coulomb, Gauss, Ampere, Faraday, and their relation to Maxwell's ferro-magnetism. Magnetic circuits, forces and torques, energy storage and flow, are also included."* The material was presented in lecture form to the entire class simultaneously three hours per week. In addition, there were two hours of recitation per week in separate sections. Three hours of laboratory per week were also required.

All eighty-six members of the junior electrical engineering class participated in the experiment, divided into four sections of approximately twenty-one students in each group. There were two remote positions with two-way video instruction, one with one-way and one live TV group. Sections rotated between these four positions, changing at about four week intervals. The three televised lectures were given by a single instructor except for a few weeks in the early part of the semester. In addition, the sections met separately for two one-hour class periods with four different instructors, one of whom was the television lecturer. The other three instructors also acted as proctors in the remote sections. One large room lecture per week was substituted for the televised lecture during the last few weeks of the semester.

This course consisted almost entirely of the derivation of mathematical equations, and as presented, required the use of large chalkboard areas, often with closely inter-related material on separate board areas. Furthermore, the course is basic for a number of courses and is generally considered difficult. It was also necessary for the students to take rather complete notes.

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*Catalog Description

A required five hour course, Electric and Magnetic Fields was being offered for the first time, taught by an instructor who had never formally presented this type of material before. It might properly be asked why, under these obviously negating conditions, this particular course was chosen. The answer is, in part, at least, that the course represented one of the most difficult types of material to be presented by television and the experience obtained would provide better answers to many problems than would be provided by a course more "naturally" suited to the medium.

Graphics I. Fall Semester, 1957

This was the same course as described for the Spring semester, 1957, but with a different group of students and with a different instructional pattern. Six of the available twenty sections were used because of their time schedules. They were divided into two groups of three sections, each meeting for a one hour lecture per week at two separate periods. Sections were rotated each week between the two remote and the live positions. All six members of the Graphics staff participated in the experiment, rotating between lecture and proctor assignments.

Graphics II, Spring Semester, 1958

" . . . a continuation of Graphics I. This includes working drawings, both fee hand and with instruments, principles of graphic presentation, the graphic arts, pictorial sketching, empirical equations, alignment charts and graphical calculus."* Exactly the same instructional pattern as for the Fall semester was followed, but with different random assignments of students to the six sections, i.e., some students may have had televised instruction during the Fall semester while others may not.

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*Catalog Description

Instructors in the Graphics courses continued to develop methods for improving the quality of their instruction. The white paper sheets initially used in the Spring semester of 1956, while giving much better contrast than chalkboards, gave rise to undesirable glare reflections. A light gray, matte surface paper was therefore substituted, taped in place on the chalkboard for use during the lecture. Sheets used measured four feet by three feet so as to give the same aspect ratio as the receiver screens. Drawings were made on the sheets before the lecture in light pencil (invisible to the class) so that excellent draftsmanship was possible by the instructor. For those cases where the drawings were quite complex, the necessity of making separate preliminary drawings for each class was avoided by covering the paper with thin cellophane and drawings made without destroying the original. The modified chalkboard lighting units were adjusted so that no specular reflection took place. Frequent use was made of models, requiring special lighting to achieve a three dimensional effect.

In addition to the regular two-way video instruction, several one-way demonstrations were made during Spring 1958, of equipment and drawing techniques which had never before been possible under conventional classroom conditions. Some of these which required special lighting conditions were presented from the studio, while others were produced from the usual television classroom. Details of the experiences with Graphics courses will be described in a separate report.

Student Achievement and Reactions of Students and Instructors, Fall and Spring Semesters, 1957-58

Electric and Magnetic Fields, Fall Semester, 1957

Student Achievement: The original plan of this study was to utilize a single instructor for the televised lectures, and to rotate the class sections among the four rooms in a prearranged manner every four weeks to determine the possible effect of the instructional method on examination grades (four exams were given during the term.) This plan was abandoned for two reasons: (a) a substitute instructor had to be used during the third, fourth and fifth weeks of the semester when the regular lecturer became ill, and (b) the substitution of large room lectures for some of the televised classes at the end of the term. Because of these changes, a comparison of grades in the various sections was not considered appropriate.

Student Reactions: Open ended questionnaires were given to all sections at the end of the term. A summary of the student's replies are given below; details of the questionnaire and a tabulation of the actual replies are presented in Appendix C.

1. Students strongly prefer, other things equal, a live to a television presentation. In addition, they prefer a two-way video section to a one-way video section.
2. If a television section of a required course were to be taught by an excellent instructor and a conventional section taught by an unknown, the majority would elect to take the television section (other things equal).
3. According to student reactions, the disadvantages of television in the Electric and Magnetic Fields course included the following:
    a) difficulty in following lectures and taking notes (because of difficulty in seeing subscripts and details of drawings on the chalkboard, and restricted view of the chalkboard on the television screen)

b) feeling of lack of contact with the instructor (because of some difficulty in asking questions, technical difficulties, and distractions from other students in remote rooms)

4. On the positive side, the majority of the students considered instructors to be better prepared before a television camera than they were in an ordinary classroom.

5. The use of television for laboratory demonstrations of small objects, intricate equipment, processes or experiments difficult to view from close-up positions, etc., is an advantage in televised instruction, but not used advantageously in this particular course.

6. The responses to many questions which required students to compare one-way and two-way video rooms, showed that the two-way system was desirable in that two-way periods were more effective than one-way. Perhaps because the instructor could call on students directly, students studied notes more throughly before class, were more alert, found it easier to communicate with the instructor, did more advance preparation, .felt generally better prepared, and had a greater feeling that the instructor wanted them to learn and understand in the two-way rooms than in the one-way rooms. However, when asked directly if they considered the two-way video system to be advantageous to the student, the majority answered "no". Those who answered in the affirmative thought that it made the class less impersonal and provided the instructor with indications of audience reaction.

7. An overwhelming majority of the students preferred a large lecture hall (seating about one hundred students) to the television presentations they had experienced in this course. They felt that in the lecture hall it was easier to ask questions, there was more feeling of instructor contact, and the whole chalkboard was constantly in sight, making it easier to see and to take notes.

Instructor Reactions: The instructor presenting the televised lectures for this course considered the restricted use of the chalkboard for a course requiring many mathematical derivations as the principle limitation for this particular course. He believed that it might be useful for some courses, particularly if a more careful preparation and attention to the limitations of the medium were made. This particular instructor was adversely affected by the presence of the camera and equipment in the live classroom.

Graphics I and II, Fall and Spring Semesters, 1957-58

Student Achievement: The distribution of final grades for the six television sections were compared with that of the fourteen non-television sections for Graphics I. A chi-square test showed the two distributions to differ significantly at the one per cent level of confidence; the television sections received the higher grades. A similar comparison of the distributions of television and non-television sections in Graphics II showed the non-television sections to have received the higher grades, but this difference might well have occurred by chance (P = .30). The grade distributions and chi-square values are presented in Appendix IV.

Student Reactions: Students in the Graphics courses were asked to complete questionnaires comparable to those given to students in the Electric and Magnetic Fields course. Their reactions are summarized below; a tabulation of actual replies is found in Appendix V.

1. Students in the Graphics courses at Case strongly prefer (other things equal) a live presentation to a television section.
2. If a TV section of a required course were to be taught by an excellent instructor and a conventional section taught by an unknown, the majority would elect to take the TV section (other things equal).
3. According to student reactions, the televised instruction produced

several disadvantages in the Graphics courses:

- a) loss of contact with the instructor (despite two-way video and audio communication)
- b) difficulty in understanding (because of restricted view of the screen and occasional technical problems)
- c) distractions from other students, passivity, inattention and sleepiness, and
- d) necessitated more time for study outside of class

4. The vast majority considered instructors to be better prepared before a television camera than they were in an ordinary classroom.
5. Because of the enlarging properties of the camera, models and appraratus were often better viewed on television than in direct classroom view .
6. Approximately sixty per cent of the students in Graphics I and forty per cent in Graphics II felt that two-way video communication is desirable. The most often mentioned reasons for its desirability were that it helped keep students alert, made it easier to ask questions and get them answered, and it helped keep the instructor aware of student reactions.

Instructor Reactions: All members of the Department of Engineering Drawing participated in the instructional program for this course. They made very careful preparation for their lectures and in most cases used some time for rehearsal. Techniques were constantly improved during the three semesters and excellent quality of presentation was obtained. All made considerably more use of the two-way facilities than was the case of instructors in the other courses. All believed it to have high positive value, and felt it contributed considerably to the effectiveness of the lecture material. Some made use of it by directing questions and comments to the remote classrooms and all felt they would have been inhibited by its removal. All instructors felt the time necessary for proper preparation was much greater than for live presentation, but believed that the lectures were more effective as a result. At the same time, all would prefer live to televised instruction, due to loss of personal contact with remote students, even with two-way video and audio operation. The reduced viewing area of remote monitors was considered the principal limitation of the two-way video system.

General Evaluation of Conditions During Fall and Spring Semesters, 1957-58

Environmental conditions during Investigation B. were satisfactory in every way and no objections nor criticisms were voiced on this point. In spite of this, both students and instructors remained critical of instructional television. In addition to the loss of personal relations and restrictions on questions and discussions, two other factors remained as objectionable features. The first of these is on technical operation. Students were hyper-critical of picture quality and expected images even superior to those of commerical programs. Occasional poor receiving conditions which would hardly be noticed for such programs were not only criticized at the time but were remembered and cited as objectionable long after a single incident. Any gaucheries of camera handling, poor contrast or focus, loss of receiver synchronization, etc., were all factors which seemed to have considerable relation to student attitudes.

With the exception of the project director and one technician, all personnel used for the production of class programs were students in the Electrical Engineering Department. Although camera operators developed skills very rapidly, control and direction techniques were more difficult to acquire, and the degree of experience in these important positions determined the technical excellence of the programs. It becomes evident that if students are to be used, their training as members of the production staff must be a continuing process. The responsibility for this training was assumed by the Student Branch of the Institute of Radio Engineers for the school year 1957-58. They not only supplied trained staff for program productions, but have also given training in a continuous maintenance program. It is not believed, however, that this would be a satisfactory condition for a long range routine televised instructional program. The constantly changing student personnel and degree of responsibiltiy, conflicts in schedules, etc., indicates that the operating technical staff should be a permanent, non-academic service organization.

The second objection to televised instruction was the limited viewing area. In conventional instruction, material once presented on a chalkboard remains in view for a comparatively long space of time. The student (and the instructor) can visually refer back to this material as the lecture procedes. In instructional television, however, the situation is much the same as if the instructor depended entirely on lantern slides for his entire class presentation. Once the slide or televised image is removed, no visual reference can be made to previous material except by awkward recall of previous slides or camera shots. This criticism is perfectly valid and remains as a major problem in effective televised instruction. One solution has been devised during the Case studies, but since it is still in the process of development it will not be described in this report.

VII. TELEVISION AS A TEACHING AID

Frequent reference has been made in this report to the use of television as an aid to instruction and to the conviction that it is probably the most satisfactory contribution which can be made to effective teaching, particularly in the physical and biological sciences. Not only can a large number of students observe objects and experiments at the same time and with equal clarity, but instructional facilities are much better utilized.

The philosophy of this viewpoint has been detailed in a previous report(7), together with an account of the associated facilities and techniques required. However, since its publication, considerable additional experience has been obtained and a brief account of this experience may be of interest.

Fall Semester, 1956

General

Demonstration of analog computer

Demonstration of digital computer (off campus)

Demonstration of digital computer (on campus, between separate buildings)

Demonstration of microwave equipment and measurement techniques

Demonstration of electrical measuring equipment and techniques

Astonomical observation of the planet Mars

Astronomical observation of the moon (public demonstration)

Spring Semester, 1957

Graphics I

Enlarged views of models

Chemistry II

Enlarged views of crystal forms and structure

Graphics II

Demonstration of specialized drawing instruments and techniques.

Fall Semester 1957

Graphics I

Continuing use of enlarged views of models.

General College Physics

Microscopic view of motion of magnetic domains.

(A motion picture showing of this phenomena was made in the Electric and Magnetic Fields course. It was generally agreed that the televised presentation was superior because of the immediacy, the control of variable conditions, the repeat factor, and the student views of necessary manipulative techniques)

Spring Semester 1958

Graphics II

Continuing use of enlarged views of models.

Repeat of demonstration of specialized drawing instruments and techniques.

Electronic Circuits

Extensive use was made of television as an instructional aid, (perhaps because the course was taught by the project director!) The class involved was the same as that which had received instruction in Electric and Magnetic Fields during the previous semester. In each case the instructor remained in a lecture room with the students and directed the demonstration being made in a remote laboratory. The following material was televised: enlarged views of electron tube construction, oscillographic plotting of tube characteristics, effect of operational parameters on tube characteristics, non-linear distortion, wave form analysis, frequency distortion in amplifiers, plate and grid modulation, demodulation, heterodyning and beats, damped oscillatory discharge.

Viewer Reactions

Except in one instance, no attempt was made to formulate viewer reaction to this form of televised instruction. In general the acceptance was very high and in many cases enthusiastic, particularly for those cases where a similar view could have been obtained in no other way. Since in the majority of cases the images were enlarged from the normal image, the problem of limited viewing area was negligible. The only criticisms were for those cases where the lecturer was at the demonstration positions and these were chiefly concerned with poor camera handling.

Electronic Circuits

A questionnaire was used to evaluate student reaction for the course in Electronic Circuits. The results of this questionnaire are especially interesting, since this was the same group who had received televised instruction in Electric and Magnetic Fields during the previous semester and might be considered as conditioned against any form of television instruction. However, the results, given in Appendix VI shows high acceptance in contrast to the attitudes toward the instructional experience in the Fields course.

Ancillary Effects

As a result of these experiences the following uses of television are planned for the future:

1. A permanent installation will be made in the Warner and Swazey astronomical observatory. Two cameras will be used, one permanently attached to the 36 inch reflecting telescope, and the other a mobile camera for showing telescope details. Images will be transmitted at video frequency (for maximum resolution) over a closed-circuit to the observatory auditorium for public and class viewing. In addition, since a standard synchronizing signal will be used in the camera operation, astronomical phenomena of general public interest will be broadcast by local commerical stations.
2. Two series of programs have been made a part of the course in freshman chemistry. These will deal with demonstrations not formerly possible because of physical limitations. They will include demonstrations of the electron microscope, X-ray diffraction equipment, small scale laboratory techniques, etc.
3. The Graphics Department will continute to demonstrate specialized drawing equipment and techniques.
4. The Physics Department will repeat the demonstrations in magnetic domains. In addition, several showings of optical phenomena are planned, but details have not been as yet completed.
5. The course in Electronic Circuits will continue to use the closed-circuit system as in the Spring of 1957, and to extend its use to include demonstrations such as phase relations in oscillators, rectifier systems and filter action, reactance modulation, frequency discrimination, etc.

It is believed that as the instructional staff becomes more aware of the advantages of television as an instructional aid, increasing use will be made of available facilities. It is possible that with this experience serving as a conditioning factor, there may be a better and more general acceptance of its use as a medium of instruction if an unfavorable student to instructor makes this desirable.

VIII. EQUIPMENT AND TECHNICAL OPERATION

Although the Case system is in general similar to other closed-circuit installations, the use of radio-frequency distribution, two-way video, multiple programs and extensive use as a teaching aid makes a short description of the physical facilities appropriate to this report.

Distribution System

The building distribution system has been described in detail in previous publications,(8), (9) but a brief review of its features may be of interest. All rooms in the Electrical Engineering Building (except service areas and offices) are equiped with wall plates on which are mounted camera, receiver and audio jacks. All camera jacks are connected to a single 73 ohm coaxial cable. This cable leads to the channel amplifiers located on the top floor of the building, with the output of these amplifiers connected by a similar cable to all receiving jacks. The audio line is a twisted pair loop with all outlets connected in parallel. Four separate channel amplifiers are tuned to channels 2, 4, 6, and 8 with provision for the addition of channels 10 and 12. These amplifiers are unattended and normally connected to the power lines continuously. Three Yagi antennas are provided for reception from the three local television stations (channel 3 converted to channel 2, channel 5 converted to channel 4 and channel 8), although they are not normally connected to the system. There are a total of 27 camera, 38 receiver and 38 audio outlets available. The reason for the greater number of receiver than camera outlets is that in large rooms several receiver outlets are often desirable for adequate viewing. Video frequency transmission may be obtained on the system by connecting video monitors to the camera lines, although this of course restricts the system to a single one-way program. The "constant level" system developed by the Jerrold Electronics Corporation permits any number of receivers on the radio frequency system to be operated without loss of picture quality.

The complete system including channel amplifiers, antennas and installation was provided by the Jerrold Electronics Corporation as a part of the Electrical Engineering Building at Case, completed in 1956.

The Two-Way System

Program Cameras and Control

Operation of the two-way system can be best understood by reference to Figures 1 and 2. Figure 1 is a block diagram of the equipment arrangement at the program originating point, for either studio or classroom instruction. Two cameras are used, each mounted on heavy duty photographic tripods and heads. The heads are adjustable in height and have been modified to permit the use of hand locking pan and tilt handles. One camera carries a three lens turret, usually fitted with 1", 2" and 3" lenses, while the other uses a 2" to 4" zoom type lens. Camera adjustments are made on a console mounted camera control unit which also contains a switching unit for connecting either camera to the line. The output from an electronic slide projector is also switched to the line at this point. Any two, or all three images can be superimposed by the switching system if desired. Two video monitors provide continuous images from the two cameras, and provision is made for viewing the video output from the slide projector. A synchronizing generator supplies pulses to the camera and line to provide a standard E.I.A. (RETMA) 525 line, two to one interlaced signal. A waveform monitor has been found to be necessary for completely satisfactory camera adjustments. A high quality cathode ray oscilloscope (such as a Tektronics Type 514 or 531) can also be used, and at about the same cost, but since such an instrument does not lend itself to the console mounting adopted for this assembly, a commerical television unit was used. The video signal modulates a crystal oscillator adjusted to the proper channel frequency, in the unit designated as an "audio-video mixer", since sound from the room microphones is combined with the picture signal at this point. The composite signal is then fed into the camera jack of the building system. With the exception of the slide projector, all of the equipment mentioned above is manufactured by the Dage Division of Thompson Products, Inc.

Program Point Monitors

In addition to the camera video monitors, a number of radio frequency monitors were also used at the program originating point. One is a 17" television receiver mounted in a standard equipment console and placed adjacent to the camera control units. This permits the control personnel to observe the same type of picture of picture being received in the remote classrooms, and also, by switching channels, images of the remote rooms can be observed.

Two 21" receivers tuned to the program frequency are placed at the instructor's position. One at the front of a classroom permits students to observe close-up or enlarged views of objects being shown by the instructor. This also eliminates parallax effects when all students should have the same view of a solid object (as in models used in the Graphics instruction). It was observed that students in the live class would often direct their attention to this monitor rather than the chalkboard for close-up views of written material, particularly if the instructor had a tendency to use small symbols. A second 21" monitor is also placed at the rear of the room. This monitor shows the instructor the same image that is being observed by the remote classes and enables a skillful teacher to better adapt his presentation to the limitations of the medium.

Two arrangements have been used for viewing the remote classrooms. In one case, 17" receivers were mounted at a slight forward angle in a desk immediately in front of the instructor. It was found, however, that in answering questions from the remote classes the instructor tended to look down into the monitors rather than toward the camera, thus destroying the illusion of direct visual communication with the remote class. A better arrangement was the use of 21" receivers mounted on mobile stands at the back of the room on an approximate line with, and slightly higher than the program cameras. Since the angular differences were small, the instructor seemed to address himself to the cameras, and so to the remote classes, even when looking at the remote monitors.

Program Point Audio Facilities

A lavalier microphone was usually used by the instructor, although boom, floor and desk mounted microphones were used at times. A microphone mixer controlled the several inputs to the audio-video mixer.

A conventional inter-com system between control operators and the instructor permitted communication without affecting the class program. Sound-power phones provided communication between all points on the system independent of program microphones.

Remote Classrooms

Figure 2 shows the arrangement of equipment used in all remote classrooms. Both the receiver and camera are mounted in a large mobile cabinet with the camera placed to the right of and centered with the receiver screen. Receivers used are 27" Setchel-Carlsons, which have been found especially suited to classroom use. In addition to the large screen size, the "unitized" construction permits rapid and easy servicing of the receiver units. (The 17" receivers used at various points in the system have the same type of unitized construction.)

Cameras used in the remote rooms are of two types, although both are industrial models with self-contained synchronizing generators and with random interlace. In one case a single 1/2", f/1.5 lens is used so as to cover the entire classroom. Since normal room lighting is used, the lens cannot be stopped down far enough to give good depth of focus. This arrangement, while satisfactory, is not as acceptable as ths second camera system described below. Not only are students in the front and rear of the room slightly out of focus, but the image of the entire room width is at all times compressed to the width of a picture tube. It is therefore difficult for an instructor to recognize individual students unless he is already well acquainted with the class. This latter difficulty was partially solved by a fixed seating assignment and a seating chart provided for the instructors use. The second type of camera is equipped with a four lens turrent carrying 1/2", 1", 2", and 4" lenses. The turret can be operated from a remote position so as to select any one of the four lenses. Pan, tilt, and optical focus are also remotely controlled, permitting the room proctor to select a close-up, medium or long shot of any individual or group in the class. Both types of cameras are easily removed from the cabinets for use on tripods if desired.

Classroom control consoles are of the same type as those used at the program position and are operated by the proctors at the rear of the classrooms. Room receivers can be adjusted by the proctor for brightness, contrast and audio level and the cameras for target, beam and electrical focus. Camera position and optical focus for the second type of camera are also controlled at this point. A 17" receiver mounted in each console serves as a monitor for the room camera. In addition, the consoles carry audio-video mixers of the proper channel frequencies.

Room microphones are usually placed to one side of the receiver-camera cabinets, and slightly behind the front surface. The position is not critical, but may need some variation to minimize the possibility of acoustic feedback. Cardioid dynamic microphones have been found most satisfactory for classroom use, but almost any type can be used if carefully positioned. Microphone levels are controlled at the consoles and sound power telephones permit the proctors to keep in contact with all other points in the system.

Electronic Slide Projector

Reference has been made at a number of points to the electronic slide projector. This unit was used to avoid the need for an optical projector for showing of lantern slides. With optical methods a camera pick-up is made of the image projected on a screen. Alternately, a special vidicon tube and optical projection unit may be used. If the camera and screen method is used, the normal room illumination must be reduced to avoid wash-out of the projected image, and one camera is taken out of service for the pick-up.

The electronic projector is simply a modification of one type of television service equipment known variously as a "video scanner", "television analyst" or "flying spot scanner". The only modification of the unit necessary is the installation of a standard lantern slide holder to permit rapid change of slides. Only the video output of the scanner is used and is switched into the audio-video mixer in the same manner as the program cameras. However, if the slide image is to be superimposed on that from the cameras, the same synchronizing sweep signal must be used for both scanner and cameras. This requires the substitution of the camera sync for that of the lantern slide scanner.

The unit is small, easily portable, and inexpensive (about the cost of a good television receiver). No room space nor screen is required as with optical projection; there are no lenses nor heat from high wattage projection lamps. Contrast and brightness of the image are electrically controlled, and the image on the television screen is usually superior than that obtained by optical projection.

Lighting

Mention has been made at several points of the comparatively low lighting levels used for most of the experimental instruction. Since this is at variance with general practice, it may be well to explain the reasons for this viewpoint. High lighting levels, unless extremely well diffused, are generally found to be distasteful to the instructor. Spot lighting in particular usually results in annoying glare, and considerable skill is required in the placement of auxilliary lighting units to eliminate deep shadows and bright high lights. Moreover, the presence of special lighting units is distracting to the student and detracts from normal classroom teaching conditions. Also, high light level units usually produce considerable heat, making expensive air conditioning mandatory in some cases, particularly where incandescent lighting is used.

The reason for the high levels often used in television instruction is probably due to their use in commercial television program productions. In this case, much of the action may require motion through a considerable distance to and from the cameras. To obtain the large depth of focus required, it is then necessary to stop down the camera lens considerably, which in turn requires high light levels to compensate for the reduced apertures. Thus a scene may be illuminated at several hundred foot candles, the lens stopped down to f/8 or f/11, but with a depth of focus resulting of 10 to 15 feet. It is also desirable at times to achieve dramatic lighting effects by the use of bright spots and deep shadows.

In classrooms, however, the instructor usually remains in a nearly fixed position relative to the camera, most motion being from one side of the room to the other, rather than toward or away from the camera. Under these conditions, a depth of focus of only four or five feet is required and 50 to 60 foot candles with a lens opening of f/1.5 is adequate for images of good quality.

When television is used as an aid to instruction rather than as a teaching medium, the problem is somewhat different. Equipment to be shown is often dark in color and in positions where the normal room level may be inadequate for good picture quality. Under these conditions auxilliary lighting is necessary. Flat lighting is desirable in most cases to avoid shadows and specular reflection from polished surfaces. Two light "boards" were designed for this purpose and are described in a previous report.(7) However, a brief description will be repeated here. Each consists of a large plywood panel mounted vertically on casters to provide mobility and ease of positioning. Each carries four pairs of four foot fluorescent lamps, separately switched from a control console. In addition there are three separate photo-flood and reflector units with six foot telescoping booms and with universal positioning mounted on the top of each "board". The spots are controlled in intensity by separate variacs also mounted on the switching console.

A detailed study of lighting problems in educational television is now in progress and will be presented in a later report.

Costs

In considering the costs of a closed-circuit instructional system, a clear distinction should be made between this type of instruction and open-circuit or broadcast educational television. The difference in objectives of both commercial and open-circuit television and of in-class closed-circuit instruction should be clearly understood.

The primary purpose of a commercial station is entertainment; it is income producing, it is highly competitive, and it has an audience with no direct financial interest, completely free to accept or reject any program presented by the station. Under these conditions it can afford to utilize the best and often the most expensive facilities available; indeed, it cannot afford to do otherwise.

Its programs must have visual appeal and variety; dramatic music and and lighting effects as well as spectacular backgrounds are often a necessary part of its presentation. Successful programs of this type require large production staffs with program, technical, lighting, and audio directors and assistants, control and camera operators as well as a staff responsible for the maintenance of the equipment. Special air conditioned, acoustically treated, large studios and control rooms are necessary, and of course, the most highly refined technical equipment available.

If educational programs are to be broadcast to the general public, much the same conditions prevail. The program is then in competition with commercial presentations, and to attract and hold a sufficiently large audience to be worth while, it must be comparable in sophistication to that of the professional presentation. The same type of facilities and personnel are required with resulting high costs, but without correspondingly high financial returns.

Unfortunately, this concept of educational television is also considered by many as a necessary characteristic of closed-circuit instruction. As a result, many instructors as well as students, may regard it as a technological monster, far removed from the traditions and basic purposes of education. Even those who may recognize its potential values may unconsciously expect the same type of sophisticated performance obtained in commercial programs, while some of the ardent proponents may insist that commercial conditions are a necessary requirement for successful televised instruction.

It cannot be denied that many classroom situations could be greatly improved by more dramatic presentations, and that a more imaginative and skillful use of available teaching resources would greatly improve the learning process. But entertainment as such is not the objective of education. Instruction in abstract as well as factual material, and training in the ability to think logically and with reason are but a few of the objectives of education which can be achieved without resorting to the practices of commercial televising. The audience is captive, and sometimes reluctant, but more often with both an intellectual and financial interest in the education process. To them, television should be stripped of its glamorous implications; it should not be considered as anything except a medium of communication to be used when superior to other methods, or when equivalent instruction could be obtained by no other means.

Much emphasis has been placed (even in this report) on the ability of television to give a superior visual presentation of objects. However, this use is limited to comparatively few courses, mostly in the sciences, and even in these abstract theory is often more important than illustrative hardware. In the vast majority of course work, dramatic presentations and visual aids are both unnecessary and inappropriate. It is difficult, for example, to imagine how a sixteen week course in advanced calculus could be glamorized by dramatization or visual aids. If it is necessary to televise instruction which is primarily of lecture type, a close-up view of the instructor and an occasional shot of charts or other supplementary material is all that is necessary for an effective presentation. This can be obtained with comparatively simple equipment.

All of the above factors were considered in the choice of equipment for the Case experiments. It was our conviction that effective closed-circuit instruction could be made without use of the elaborate and expensive facilities necessary for open-circuit or professional operation. Actually, because of the additional cameras required for the two-way system, costs are higher than would have been necessary with the more usual one-way type of instruction. For two-way operation, industrial types of cameras are quite satisfactory, but we now believe that somewhat higher grade cameras should have been used at the program originating point. Otherwise all equipment proved to be very satisfactory.

A summary of the cost of major items of equipment is given below. The figures given are approximate, since in several cases items were purchased as part of a single package, making separation of these costs difficult. In other cases use was made of facilities already available, although these are included in the approximate costs. Since the distribution system was a part of the Electrical Engineering building, costs of this installation has not been included. Details can be obtained from the authors if further information is desired.

Cameras			
	2 - Industrial type, one with remote control	$ 3500.00	
	2 - "Educational" program type with control equipment	$ 5200.00	$ 8700.00
Auxilliary Camera Equipment	Video and wave form monitors, sync generator, lenses, tripods, etc.		5100.00
Audio-Video Mixers	(Necessary for r.f. distribution)		1100.00
Receivers	Three room receivers, 27", four r.f. monitors, 21", four r.f. monitors, 17"		2200.00
Special Illumination	Chalkboard unit, light boards, controls, etc.		500.00
Miscellaneous			1100.00
		TOTAL	$ 18,100.00

General

Throughout this report two major viewpoints as to equipment and facilities have been emphasized. These are, maximum mobility and flexibility of equipment, and minimum costs consistent with acceptable operation. It is believed that both of these objectives have been attained. Not ony can the equipment be rapidly changed from one position in the Electrical Engineering building to another, but it can also be easily set up for operation in any other building on the Case campus. Any of the separate units can be combined with other components when desired.

IX. FUTURE PLANS

Although present conditions at Case Institute of Technology do not justify the continued use of television as a teaching medium, continued use will be made of our facilities as an aid to instruction.

In addition, studies will be made on improved techniques and facilities. The following specific topics are planned or under present study:

1. Lighting problems in educational television (now being studied)
2. Wide screen, stereophonic educational television (now in development)
3. Improvements in the remote carrier control system (now in development)
4. Simplified split screen techniques.
5. Optimum viewing room conditions for educational television.

X. CONCLUSION

The studies described in this report were made possible by two grants from the Committee on the Utilization of College Resources of the Fund for the Advancement of Education. The grants total $36,500.00 and were supplemented by an additional grant of $2,045.00 from the Case Research Fund. It is hoped that the results of the studies will be of value not only to those already active in television instruction, but to all who may plan to utilize this important and challenging educational implement in the future.

References

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3. "Experimental Study in Educational Procedures" Miami University, 1 October 1958
4. "Experimental Study in Educational Procedures" Report No. 2, Miami University, 1 October 1957
5. "Closed-Circuit Television as a Medium of Instruction" New York University, October 1956
6. "An Inventory of Instructional Television Research" Hideya Kumata. Michigan State University, 1 December 1956
7. Report No. 948-4. "Closed-Circuit Television as a Teaching Aid" Case Institute of Technology, 1 August 1957
8. Report No. 948-1. "Two-Way Educational Closed-Circuit Television" Case Institute of Technology, 15 January 1957
9. "Developments in Closed-Circuit Television" M. H. Kraus. Electrical Engineering, Vol. 74, No. 11, Nov. 1955, pp 974-79
10. Report No. 948-2. "Remote Control Carrier System in Two-Way Closed-Circuit Educational Television" Case Institute of Technology, 15 February 1957

ILLUSTRATIONS

Figure 1. Block diagram, program originating point.

Figure 2. Equipment used at program originating point. Two light boards are also shown; the control for these lights is the console on the left side of the photograph. The electronic slide projector rests on the top of this and the second console. Other consoles are (left to right), video monitor for camera 1, main control console, video monitor for camera 2, and r.f. line monitor. The main control console carries the following (top to bottom): wave form monitor, elapsed time meters for each camera and video switch for electronic projector, camera control and switcher, audio mixer and intercom control, synchronizing generator, audio-video mixer.

Figure 3. Block diagram, remote classroom.

Figure 4. Remote classroom receiver with room camera, and room console control unit. The image of the class as selected by the room proctor is observed in the console monitor. Room camera and room receiver controls are immediately below the monitor, while the audio-video mixer is shown at the bottom of the unit.

Figure 5. Instructor in the originating classroom. The room monitor for use by the class is on the left, and a portion of the modified chalkboard lighting unit may be seen at the top of the photograph.

Figure 6. Live class at the instructor position. The instructors room monitor is at the rear of the classroom. The two monitors at the front show two remote classes.

Figure 7. Remote class. The image of the instructor is seen in the receiver at the front of the room, while the class image is shown on the control console monitor. (Compare with Figure 6)

Figure 8. Studio control room. The equipment is that shown in Figure 2 when a studio is used as the program originating point. The studio monitor, one light board, two cameras and one remote room monitor can be seen through the windows that separate the control room from the studio.

Figure 9. Instruction from studio. Room monitor and one light board are on the right side of the photograph. The remote room monitors are not visible, since they are located behind the cameras.

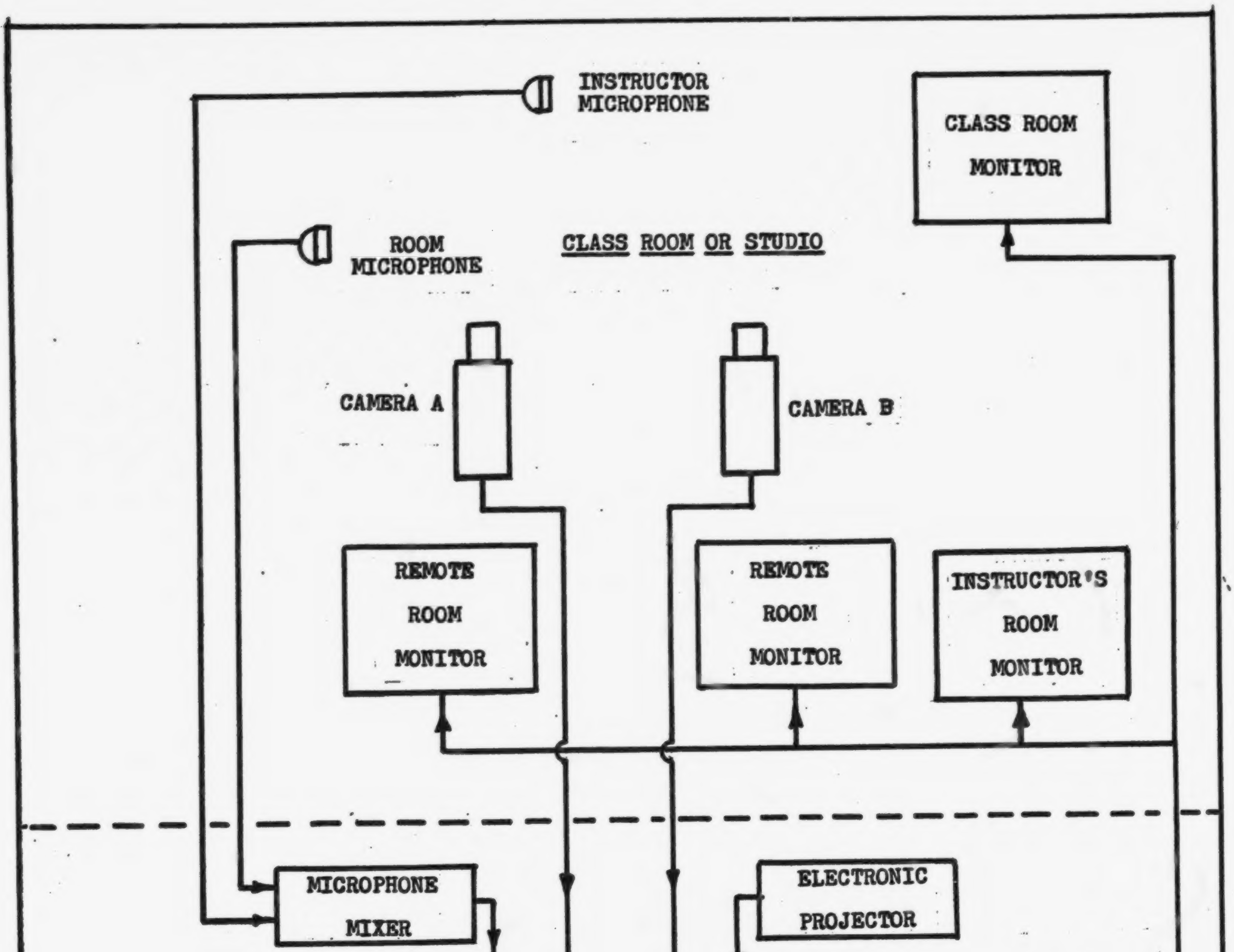

INSTRUCTOR MICROPHONE
CLASS ROOM MONITOR
ROOM MICROPHONE
CLASS ROOM OR STUDIO
CAMERA A
CAMERA B
REMOTE ROOM MONITOR
REMOTE ROOM MONITOR
INSTRUCTOR'S ROOM MONITOR
MICROPHONE MIXER
ELECTRONIC PROJECTOR
CONTROL POSITION
VIDEO MONITOR
CAMERA CONTROL AND SWITCHER
VIDEO MONITOR
WAVE FORM MONITOR
AUDIO-VIDEO MIXER
LINE MONITOR
SOUND POWER PHONES
TO BUILDING DISTRIBUTION SYSTEM

FIGURE 1

PROGRAM ORIGINATING POINT

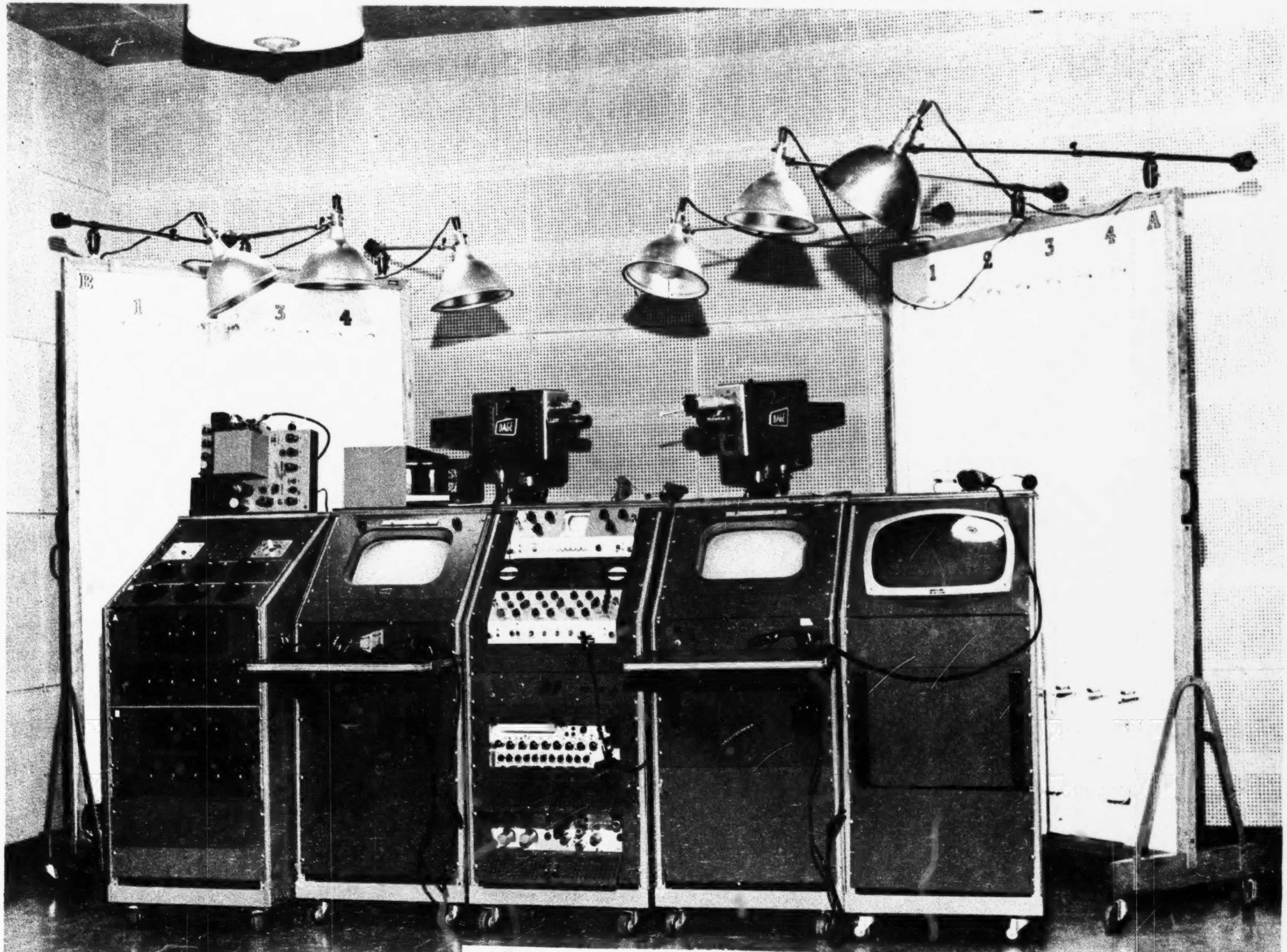

B
1
3
4
DAGE
DAGE
1
2
3
4
A

FIGURE 2. EQUIPMENT AT PROGRAM ORIGINATING POINT

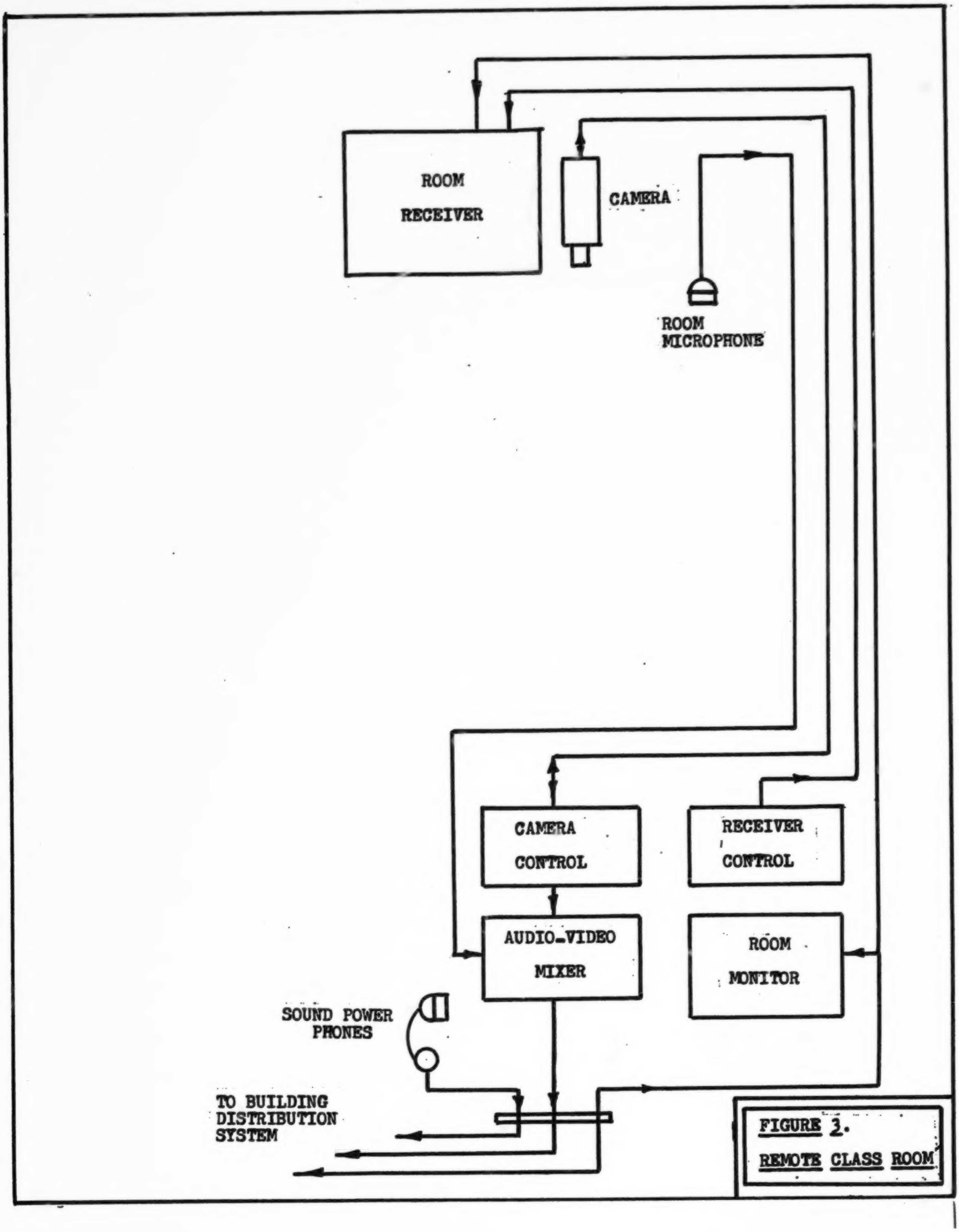

ROOM
RECEIVER
CAMERA
ROOM
MICROPHONE
CAMERA
CONTROL
RECEIVER
CONTROL
AUDIO-VIDEO
MIXER
ROOM
MONITOR
SOUND POWER
PHONES
TO BUILDING
DISTRIBUTION
SYSTEM

FIGURE 3.

REMOTE CLASS ROOM

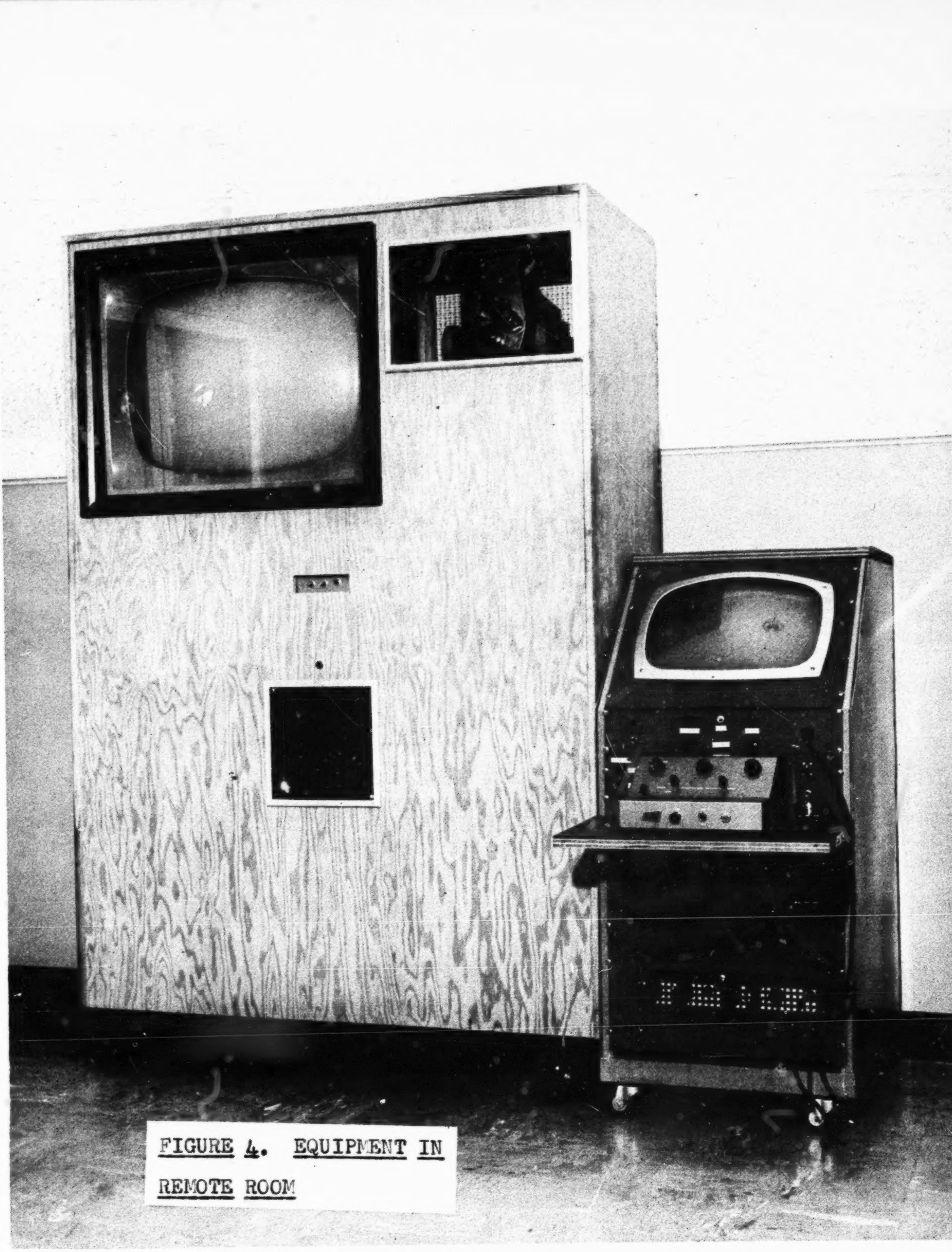


FIGURE 4. EQUIPMENT IN REMOTE ROOM

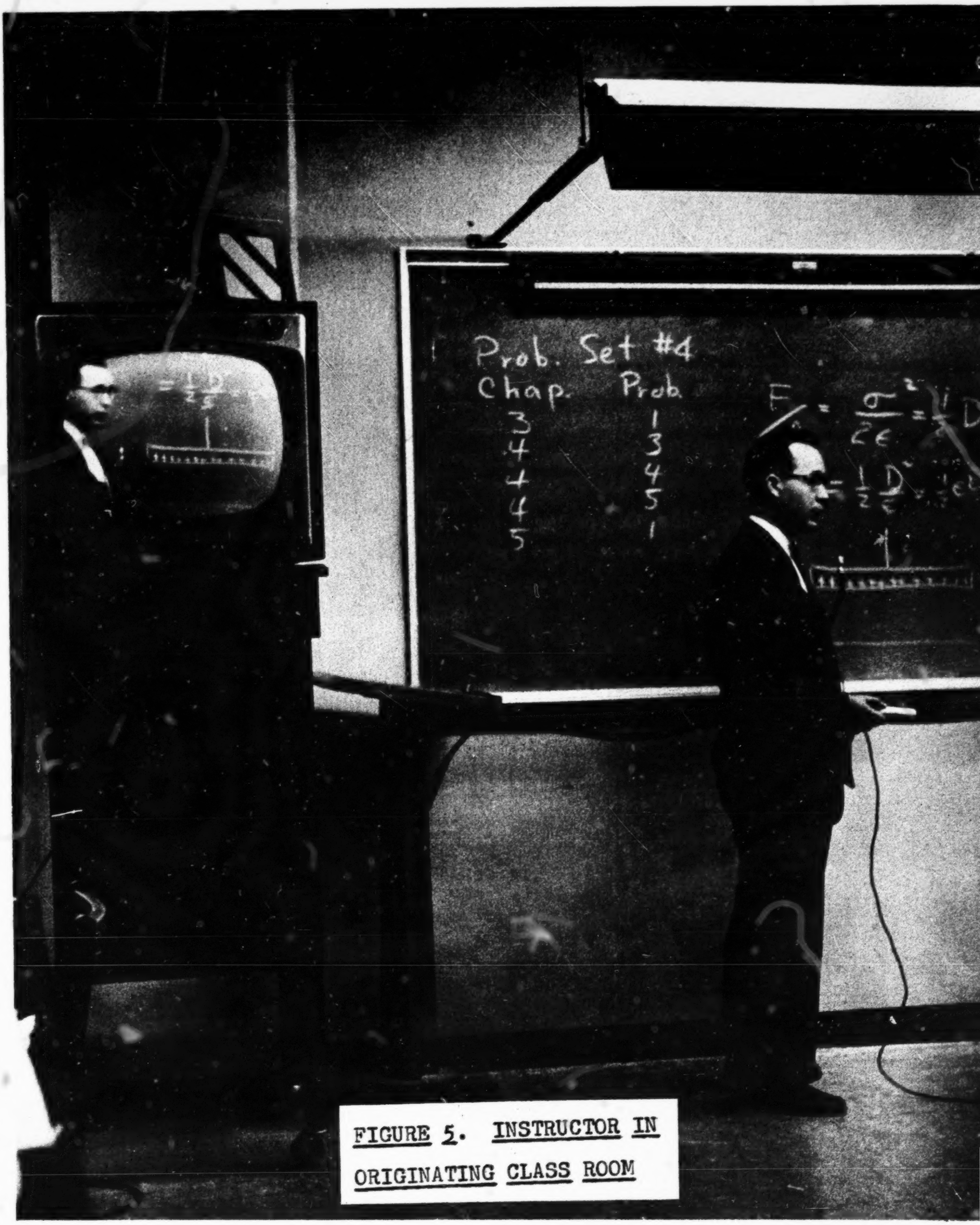

Prob. Set #4
Chap. Prob.
3 1
4 3
4 4
4 5
5 1

FIGURE 5. INSTRUCTOR IN ORIGINATING CLASS ROOM

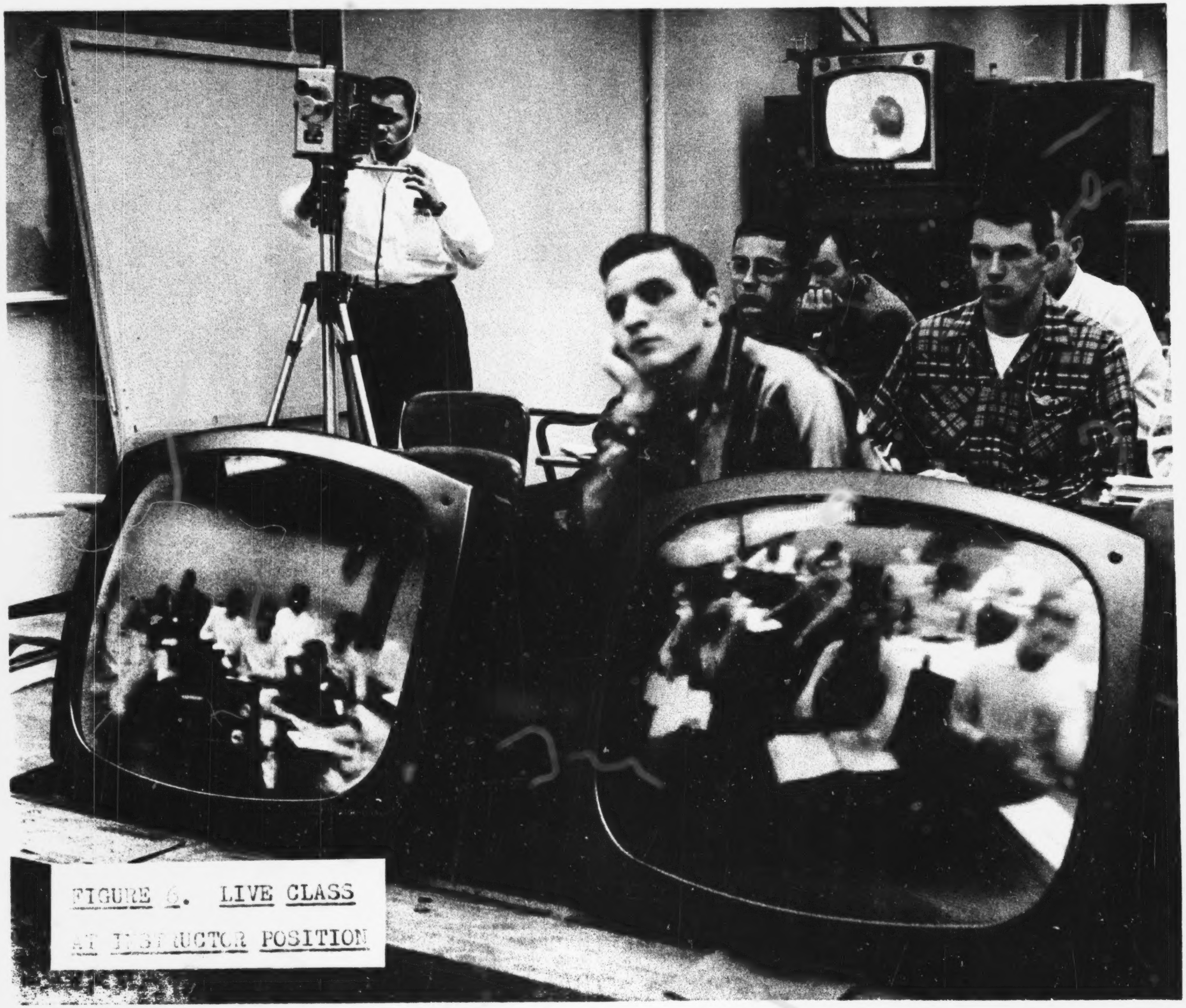


FIGURE 6. LIVE CLASS

AT INSTRUCTOR POSITION

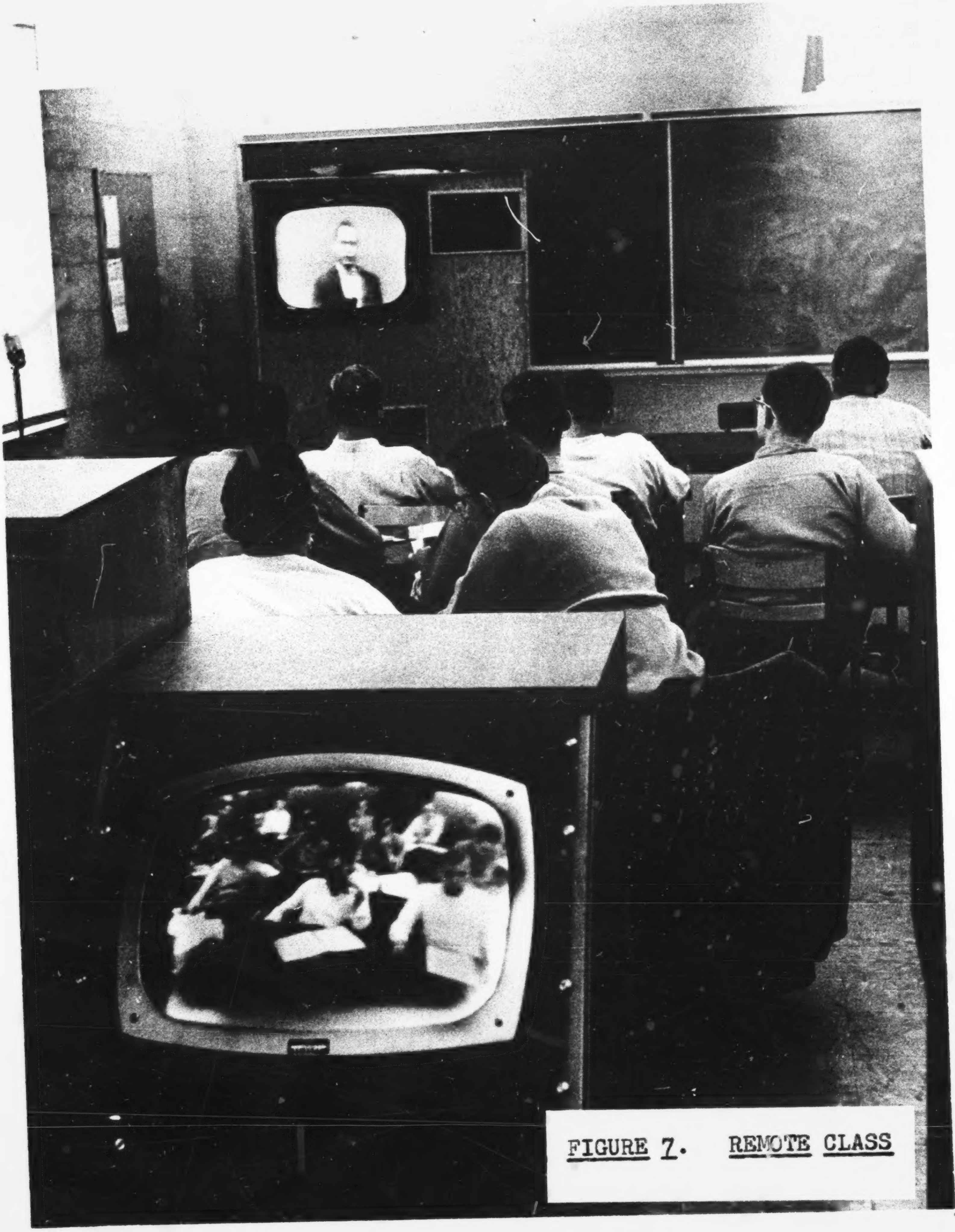


FIGURE 7. REMOTE CLASS

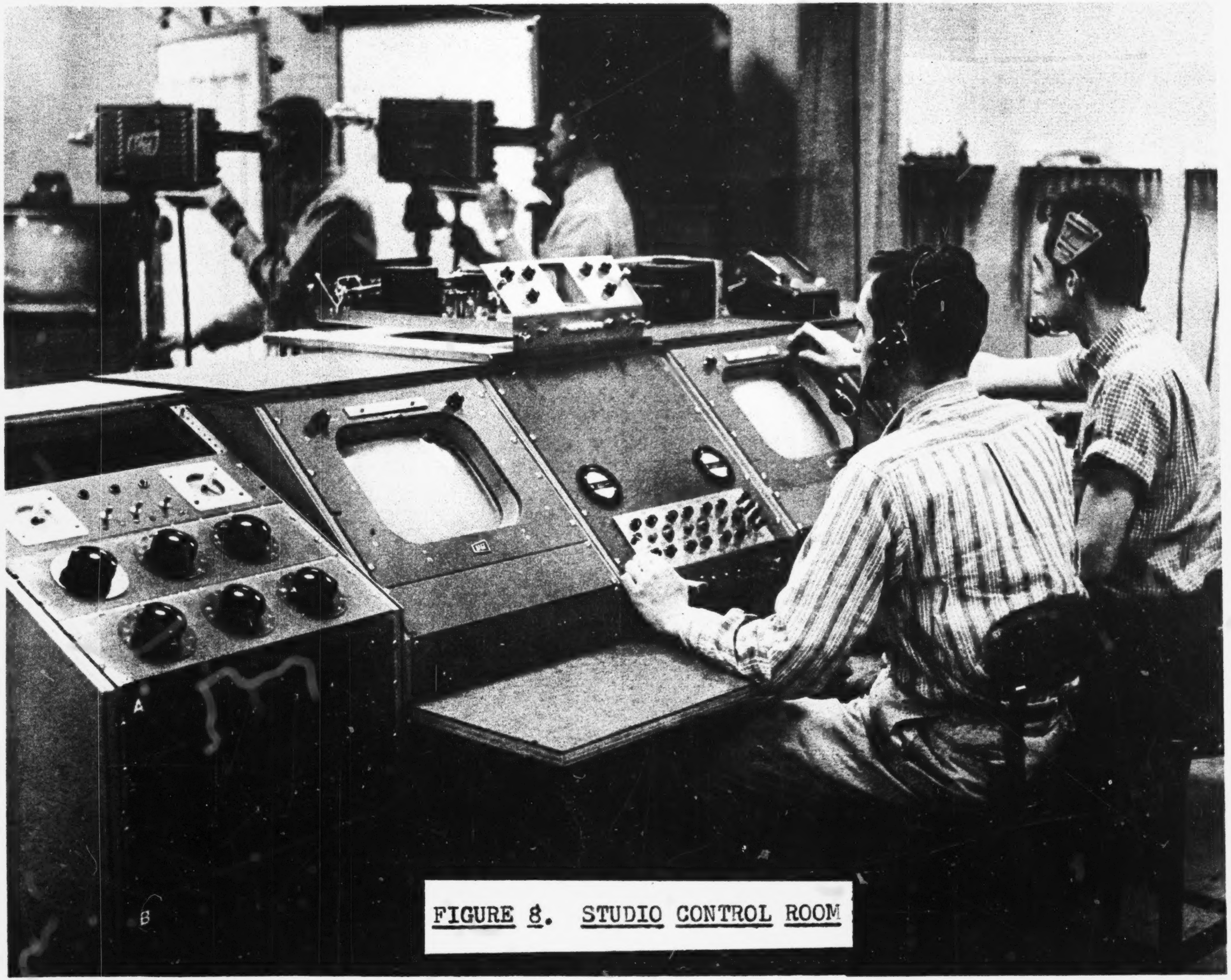
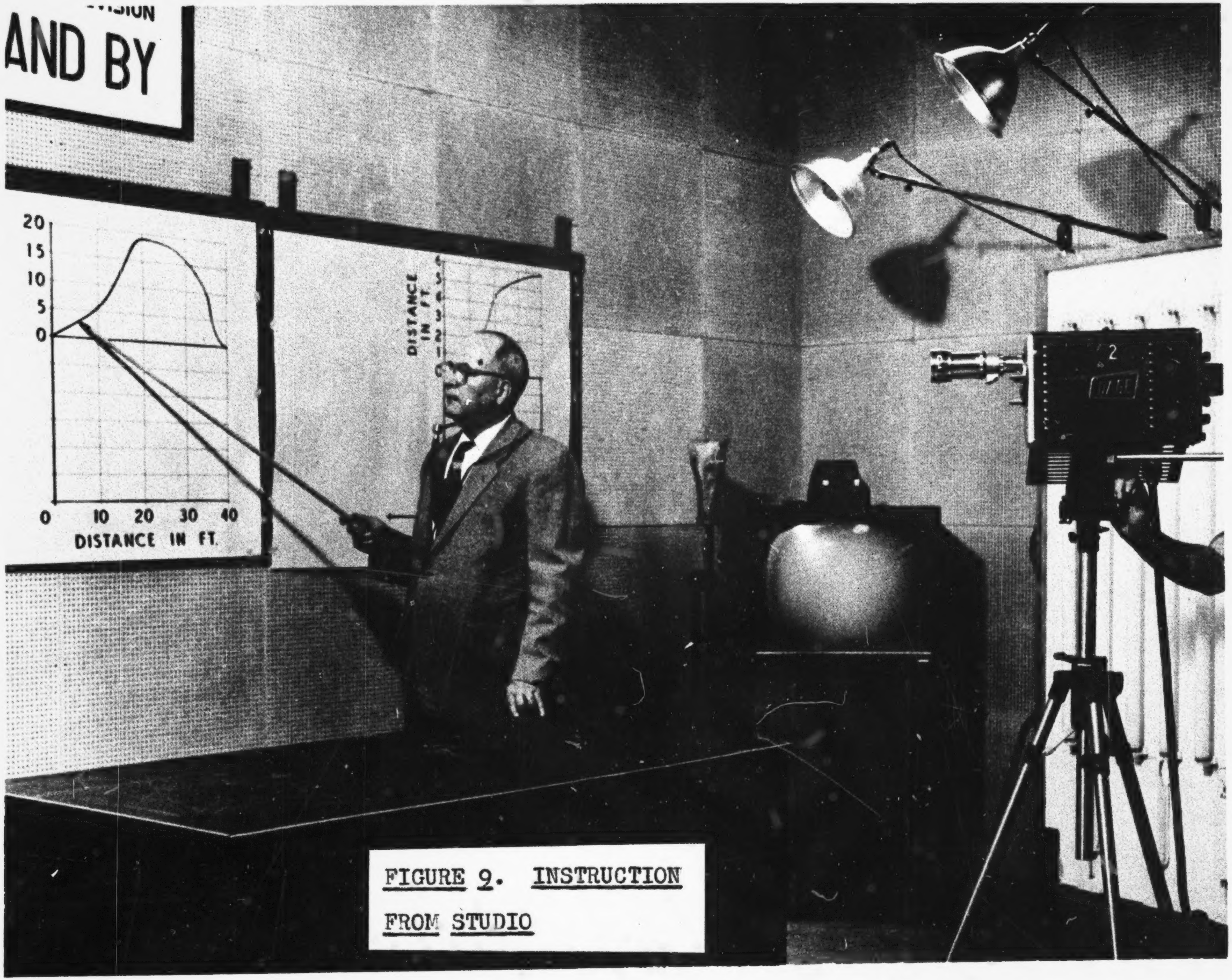


FIGURE 8. STUDIO CONTROL ROOM


AND BY
20
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0 10 20 30 40
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DISTANCE IN FT.
2

FIGURE 9. INSTRUCTION FROM STUDIO

APPENDIX I

Investigation A. Questionnaire and Replies of Students in Graphics I Spring Semester, 1957

1. Do you have a preference for the remote classroom, the live classroom, or alternating from remote to live classroom?

Remote 2%   Live 94%   Alternating 4%

2. If you were to take this course again, and you were to see and hear all the lectures in the remote room, which would you prefer?

Two-way voice and vision 70%   Two-way voice, one-way vision 24%
One-way voice, two-way vision 0%   One-way voice and vision 6%

3. How much do you feel you learned from the lecture in the remote classroom compared to how much you learned in the live classroom?

Much more in remote 2%   A little more in remote 2%
About the same in both 2%   A little more in live 36%
Much more in live 58%

4. Did the TV affect your interest and attention in following the lectures?

In remote classroom (check one)

Increased 15%   Decreased 58%   Did not affect 23%

In the live classroom (check one)

Increased 21%   Decreased 34%   Did not affect 45%

5. Some people have observed that from the student's viewpoint, the live classroom is the same as a conventional classroom. Do you

Agree strongly 23%   Agree somewhat 32%   Disagree somewhat 30%
Disagree strongly 11%   No opinion 2%   No answer 2%

6. Please consider all the lectures you saw and heard in the live and remote classrooms. Do you feel that the lectures were (check one)

Unsatisfactory because of TV 9%   Less effective because of TV 68%
As effective by TV 6%   More effective because of TV 11%
No answer 2%   Unusually effective because of TV 4%

7. Please imagine that you had the choice of enrolling in either a TV section or a conventional section of a particular course. Now, if both sections were to be taught by the same instructor (whom you like) and are offered at desirable hours which fit in with your schedule, which section would you choose?

TV section 4%   Conventional section 94%   No answer 1%

8. Suppose the TV section is to be taught by an instructor who has the reputation of being an excellent teacher, whereas in the conventional section you would have to take a chance on instructor assignment. Which section would you choose?

TV section 53%   Conventional section 45%   No answer 2%

9. Assume that you have the choice of enrolling in any one of the following sections of a course that you were required to take. Assume further that each section was to be taught by the same instructor (whom you like) and are offered at time that fit in with your schedule. Please indicate your first, second, and third choice.

1st	2nd	3rd	
2%	4%	9%	conventional section in large lecture hall with 200 students
2%	19%	4%	conventional section in large lecture hall with 200 students --- TV receivers would be scattered throughout the hall so that you could see close-ups of the instructor.
83%	-	4%	TV live section with 25 students
-	2%	2%	TV remote section with 25 students - section would be one-way voice and vision
13%	30%	11%	TV remote section with 25 students - section would be two-way voice and vision
-	-	2%	TV remote section with 25 students - section would be one-way voice and two-way vision
-	15%	28%	TV remote section with 25 students - section would be two-way voice and one-way vision

(30% made no second choice)   (40% made no third choice)

APPENDIX II

Investigation A. Mean Predicted Final Grade Indices and Mean Final Earned Grades for Two Remote, One Live, and One Conventional Section of Chemistry II, Spring 1957

Section	Mean Predicted Grade	Mean Actual Grade	Difference Predicted Minus Actual
Remote No. 1	1.57	1.47	.10
Remote No. 2	1.52	1.42	.10
Live	1.52	1.09	.43*
Control	1.20	1.35	-.15

*Significant at 1% level of confidence

Analysis of Variance of Final Earned Grades in Chemistry II, Spring 1957

Source	Sum of Squares	df	Mean Sum of Squares	F
Performance Level	38.2	2	19.2	39.92*
Classroom Sections	6.2	3	2.07	3.98*
Levels x Classrooms	1.78	6	.30	.58
Residual	37.35	72	.52	

*Each of the four groups was subdivided into three groups based upon the predicted final grade index.

APPENDIX III

Investigation B. Questionnaire and Replies of Students in Electric and Magnetic Fields, Fall Semester 1957

(Replies of 64 of the 86 students enrolled)

	Live Presentation	TV Presentation	Tie	No Reply	One-Way TV	Two-Way TV	Tie	No Reply
1. In which situation did you see the instructor better?	93	3	2	2				
2. In which situation were you able to concentrate better?	70	19	2	9	24	11	9	56
3. Where was it easier to see the blackboard?	95	5	0	0				
4. Where was it easier to hear the instructor?	63	23	14	0				
5. Where was it easier to take notes?	75	20	2	3	14	16	14	56
6. All-in-all, where were class periods more effective?	70	19	5	6	11	25	11	53
7. Before which classes did you study your notes more throughly?	50	16	20	14	6	19	17	58
8. In which classes do you think you were more alert?	64	28	3	5	11	28	8	53
9. When you wanted to communicate with the instructor, in which classes did you find it easier?	93	0	3	0	2	28	11	59
10. For which type presentation did you do more advance preparation?	52	17	22	9	8	22	19	51

	Live Presentation	TV Presentation	Tie	No Reply	One-Way TV	Two-Way TV	Tie	No Reply
11. For which presentations do you feel you were generally better prepared?	57	9	25	9	8	23	22	47
12. For which classes was a greater amount of study time necessary for an equal degree of understanding?	8	58	19	15	14	16	22	48
13. In which situation did you have the greater feeling that the instructor wanted you to learn and understand the material presented?	64	14	16	6	3	14	19	64
14. In which situation were there more distractions from comments or noise on the part of other students?	14	69	3	14	33	14	9	44
15. Imagine that you could select one of the sections of a particular course both of which were taught by an instructor whom you like, and both offered at desirable hours which fit into your schedule. Which section would you choose?	86	6	3	5	22	50	5	23
16. Suppose the television section was to be taught by an instructor who has the reputation of being an excellent teacher whereas in the conventional section you would have to take a chance on instructor assignment. Which section would you choose.	34	62	2	2				

Appendix III (continued)

17. Do you think that instructors are better or worse prepared for a lecture before a television camera than they would be in an ordinary classroom?

Better 55% Worse 25% Tie 14% No Reply 6%

18. How available was your instructor for help outside of class?

Very 61% Somewhat 15% Not at all 2% Don't know 7%
Not too helpful 2% Went to instructor of section 2%

19. On the basis of your experience, what do you consider to be the advantages of closed-circuit television in education?

More students per qualified teacher 55% For demonstrations 28%
For viewing small apparatus 12% None 9% Other 13%

20. On the basis of your experience, what do you consider to be the disadvantages of closed-circuit television in education?

Difficult to see chalkboard	36%	Technical difficulties	25%
Difficult to ask questions and have them answered	25%	Feeling of lack of contact with instructor	25%
Restricted view of chalkboard	22%	Hard to pay attention	15%
Distractions	13%	Hard to take notes	11%
Other	25%		

21. Are there courses where you think television instruction would be appropriate or desirable?

Yes 70% No 27% No Reply 3%

Laboratory demonstrations	30%	Western Civilization	25%
Graphics	13%	Lecture courses with little or no use of blackboard	9%
Humanities	8%	Other	11%

22. Are there courses in which you think television instruction would be inappropriate or undesirable?

Yes 92% No 2% No Reply 6%

Most or all	20%	Classes using an expanse of blackboard	17%
Any technical course	16%	Any theory course	14%
Electromagnetic Fields	12%	Courses requiring derivation	9%
Courses requiring discussion or questions	9%	Mathematics	8%
Other	11%		

APPENDIX IV

Investigation B. Distribution of Grades in Graphics I, Fall 1957 for Televised and Non-Televised Classes

GRADE

CLASS	A	B	C	D	F	W	Number of Students
Televised	28%	31%	24%	5%	8%	3%	156
Non-Televised	17%	30%	29%	15%	4%	5%	345

x^2 = 17.8771 significant at 1% level of confidence

Distribution of Grades in Graphics II, Spring 1958 for Televised and Non-Televised Classes

GRADE

CLASS	A	B	C	D	F	W	Number of Students
Televised	9%	45%	34%	6%	4%	3%	164
Non-Televised	13%	54%	24%	5%	3%	2%	279

x^2 = 6.7068 not significant

APPENDIX V

Investigation B. Questionnaires and Replies of Students in Graphics I (Fall 1957, replies of 113 students) and Graphics II (Spring 1958, replies of 90 students)

		Live %	TV %	Tie %	No Answer %
1. In which situation did you see the instructor better?	Graphics I	92	4	4	0
	II	95	2	3	0
2. In which situation were you able to concentrate better?	Graphics I	72	18	9	1
	II	84	13	3	0
3. Where was seeing of the drawings better?	Graphics I	84	12	2	2
	II	86	11	3	0
4. Where was seeing of the models better?	Graphics I	58	37	5	0
	II	42	50	8	0
5. Where was it easier to hear the instructor?	Graphics I	53	16	31	0
	II	64	17	19	0
6. Where was it easier to take notes?	Graphics I	62	19	17	2
	II	68	19	12	1
7. All-in-all, where were class periods more effective?	Graphics I	81	11	7	1
	II	82	14	4	0
8. In which classes do you think you were more alert?	Graphics I	76	20	3	1
	II	82	14	4	0

		Live %	TV %	Tie %	No Answer %
9. When you wanted to communicate with the instructor, in which class did you find it easier?	Graphics I	82	5	12	1
	II	95	3	2	0
10. For which classes was a greater amount of study time necessary for an equal degree of understanding?	Graphics I	10	50	36	4
	II	20	61	18	1
11. In which situation did you have the greater feeling that the instructor wanted you to learn the material presented?	Graphics I	44	20	34	2
	II	66	16	18	0
12. In which situation were there more distractions from comments or noise on the part of the other students?	Graphics I	19	71	8	2
	II	30	60	10	0
13. Imagine that you could choose between enrolling in a live or television section of a particular course. If both sections were to be taught by the same instructor (whom you like) and are given at desirable hours which fit into your schedule, which would you choose?	Graphics I	87	9	4	0
	II	90	8	1	1
14. Suppose the television section was to be taught by an instructor who has the reputation of being an excellent teacher whereas in the conventional section you would have to take a chance of the instructor assignment. Which section would you choose?	Graphics I	24	69	5	2
	II	38	55	6	1

15. Do you think that instructors are better or worse prepared for a lecture before a television camera then they would be in an ordinary classroom?

	Better %	Worse %	Tie %	No Answer %
Graphics I	84	3	12	1
II	74	8	17	1

16. How available were your Graphics instructors for help outside of class?

	Special Sessions	Always	Sometimes	Never	Don't Know	No Answer
I	2	49	6	6	32	5
II	0	67	8	1	19	6

17. On the basis of your experience, what do you consider to be the advantages of closed-circuit television in education?

	Graphics I	II
Better teacher preparation	43	16
More students per teacher	33	31
Improved standard lecture content	21	14
Improved concentration	12	4
Larger audience for outstanding speakers	9	11
Models and details are seen better	17	0
Other	13	3
None	11	11

18. On the basis of your experience, what do you consider to be the disadvantages of closed-circuit television in education?

	Graphics I	II
Understanding hampered by limited view	66	29
Lack of contact between students and instructor	43	38
Hard to pay attention	38	35
Technical problems	26	34
Other	19	9

19. Are there courses where you think television instruction would be appropriate or desirable?

	Yes	No	No Answer
I	60%	36%	4%
II	56%	33%	8%

Order (Only those courses mentioned by five or more students in one of the courses are included.)

Chemistry
Graphics
Composition
Lecture demonstration
Physics
Democracy
Calculus
No blackboard work or demonstration unless "close-up"was needed

Questionnaire on Televised Instruction (continued)

20. Are there courses where you think television instruction would be inappropriate or undesirable?

	Yes	No	No Answer
I	91	7	2
II	89	3	8

Order (Only those courses or comments mentioned by five or more students in one of these courses are included.)

- Physics
- Democracy
- Mathematics
- Graphics
- Humanities
- Any course with many questions required of students or teacher, or class discussion
- Calculus
- Chemistry
- Any technical science course
- Composition
- Most or all
- Laboratory Courses

21. Is it advantageous to a student in a remote room for the instructor to be able to see him in his remote monitor?

	Yes	No	Tie	No Reply
I	59%	29%	5%	7%
II	37%	47%	0%	16%

	I	II
Less impersonal	25	7
Informs instructor of audience reaction	25	8
Reminds instructor of audience	25	4
Keeps students alert	22	9
Instructor has better control	22	4
Easier to ask questions	11	11
Can be recognized by instructor by name	7	3
More like regular class	5	1

23. Please indicate any additional comments.

Feeling expressed that TV not necessary at Case, not consistent with catalog statements and tuition charges

Rooms with windows and ventilation would help (forced ventilation is the same in all rooms - complaint was made regarding TV rooms, not live room)

Seemed silly to watch TV while department head sat in room and watched.

APPENDIX VI

Ratings of Teaching Aid Demonstrations - Class in Electronic Circuits Spring Semester, 1958 - Percentage of Replies from 86 Students

	Good	Acceptable	Poor	Not Acceptable	No Answer
Content					
Importance	86	12	0	0	2
Meaningfulness	83	15	0	0	0
Level of Interest	75	21	1	0	3
Appropriateness	88	11	0	0	1
Presentation					
Effectiveness	73	27	0	0	0
Organization	70	29	1	0	0
Preparation	76	20	0	0	4
TV Operation					
Focus	55	37	6	0	2
Contrast	59	34	6	0	1
Brightness	63	29	5	0	3
Camera Angles	65	27	0	0	8

Comments

"Excellent shows in all ways. Keep up the good work." "Good shows" "O.K." "Use more television for these types of demonstrations." "TV is good when used in this way, but not as a medium of instruction." "Continue to use *in this way only*." "Very well used in these particular cases." "Demonstrations very good." "These were excellent."

(No unfavorable comments were received for any presentation, although the questionnaires show some adverse reactions.)